İSTANBUL TECHNICAL UNIVERSITY ★ INSTITUTE OF SCIENCE AND TECHNOLOGY

A KNOWLEDGE MAP STRATEGY MODEL FOR THE PILOTS

MSc. Thesis by

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Department : Interdisciplinary

Programme: Defence Technologies

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

PİLOTLAR İÇİN OLUŞTURULAN BİR BİLGİ HARİTASI STRATEJİ MODELİ

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PREFACE

Recently specialized computer-based systems are being more commonly used by the military and industry. These systems provide process and strorage knowledge in an easier way.

The factor which proves knowledge management system succes is the efficiency it brings. Efficiency of knowledge management system is related to its relevance to requirements and its accurate usage.

Aviation management and operations for pilots is very difficult to handle. There are many different issues and publications and relations. It is very benefical to see all aviation related issues in one system which is working very effectively.

Knowledge map as a kowledge management tool which shows how the knowledge will be used in the organisation is the subject of this thesis. In this study, knowledge maps, knowledge mapping techniques and knowledge management issues for pilots have been researched. Software applications existing in the market have been reviewed and compared. Problem areas and the extensive knowledge requirements have been identified and solutions to the problems were produced .

In concluding this study I would like to give my appreciations to Prof. Dr. Alim Rüstem Aslan who gave me continuous encouragement and support during my entire education period at İstanbul Technical University.

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February, 2007 Volkan İBRİŞİMOĞLU

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LIST OF ABBREVIATIONS

ATC	**:** Air Trafic Control
EC	**:** Electronic Crewmember
HTML	**:**Hyper Text Markup Language
ICAO	**:** International Civil Aviation Organisation
NOTAM	**:** Notification to Airman
NRDC	**:** Nato Rapid Deployable Corps
RTF	**:** Rich Text Format
SOP	**:** Standart Operation Procedures
SVG	: Scalable Vector Graphics
SWOT	**:** Strengths – Weakness – Opportunities - Threats
GPL – GNU	**:** General Public License

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A KNOWLEDGE MAP STRATEGY MODEL FOR THE PILOTS

SUMMARY

Over time, intellectual capital has gained greater importance for organizations. The most reliable source of information for organizations is knowledge; this exists in two forms; explicit and tacit. Tacit knowledge exists in the minds of employees, in their experiences and talents, intellectual models and exchanges with the outside world, and are very complex. Explicit knowledge is easier to identify, consisting of shaped models, rules, procedures and external communication. Knowledge maps are one of the best ways of finding out and sharing tacit and explicit knowledge and presenting this knowledge to employees and the other members of an organisation.

The knowledge map is a tool that shows the relationship between knowledge deposits and the importance of that knowledge. Knowledge maps are products of synthesis, which including knowledge sources in organizations, its flow, limits and losses. They are used to learn the specialization and roles of the organization's members, and to identify the limitations of knowledge flow. They focus on opportunities to increase the quality of knowledge, the locations of aimed knowledge particles the value owners give to it and how they use it in a continuous process in an organization. Knowledge mapping is defined as additional knowledge creation by combining knowledge elements.

This study considers components for flights relevant to pilots, and identifies problem areas. In conclusion, a knowledge map model has been proposed that overcomes any problems related to pilots, to improve their level of aviation knowledge, in order to achieve standardisation and improve flight safety.

This allows pilots to access knowledge faster, but tidy and accurate keeping, and pilots' ability to understand this knowledge become most important: therefore they need to know what knowledge they have and how to use it.

Significant benefits identified include: 1) the potential to reduce the operational burden on pilot's information and knowledge collection procedures, so allowing the potential allocation of this time to flight preparation and primary mission accomplishment; and 2) The ability to provide tailorable, near-real-time information about aviation to decision makers at all levels as a decision support tool.

The main purpose of the research is to support aviators in creating a knowledge map model for the pilots where they can share knowledge and best practices as well as lessons-learned in the implementation of initiatives. Knowledge maps have the potential to reduce the time and complexity of pilots' knowledge-collection procedures, providing tailorable, near-real-time information about aviation regulations, meteorology, technical and maintenance issues and all aviation publications to decision makers, at all levels, as a decision support tool.

This thesis describes the knowledge maps including knowledge mapping, aviation knowledge that should exist on maps; observations on different nations' pilots procedures and processes while they are at their workstations, deductions from the thoughts of pilots by two questionnaires, identification and study on some knowledge-mapping software applications and comparsion of these applications, and, finally, a model produced with the Freemind knowledge-mapping software application.

PİLOTLAR İÇİN OLUŞTURULAN BİR BİLGİ HARİTASI STRATEJİ MODELİ

ÖZET

Entellektüel sermaye organizasyonlar için zamanla daha büyük bir önem kazanmıştır. Organizasyonlar için en güvenilir enformasyon kaynağı bilgidir. Bilgi açık ve örtülü olmak üzere iki şekilde bulunur. Örtülü bilgi çalışanların zihinlerindeki tecrübe, yetenek, entellektüel model ve dış dünyayla temas neticesinde oluşan değerler olup çok kompleks bir halde bulunmaktadır. Açık bilgi ise şekillenmiş modeller, kurallar, prosedürler ve dış iletişimden ibaret olup tesbit edilmesi daha kolaydır. Bilgi haritaları örtülü ve açık bilginin bulunması, paylaşılması ve bilginin çalışanlara ve organizasyonun diğer üyelerine sunulması sürecinde en iyi yollardan biridir. Bilgi haritası bilgi kaynakları arasındaki ilişkiyi ve bilginin önemini gösteren bir araçtır. Bilgi haritaları organizasyonlardaki bilgi kaynaklarını, bilgi akışını, bilginin sınırlarını ve bilgi kayıplarını da içeren sentezlerin bir ürünüdür. Bilgi haritaları organizasyon üyelerinin uzmanlık alanlarını, rollerini ve organizasyondaki bilgi akışının sınırlamalarını tesbit etmek için kullanılırlar. Bilgi haritaları bilginin kalitesini arttırmak için oluşabilecek fırsatlara, sahiplerinin bilgi parçalarına verdiği değeri tesbite ve bir organizasyonda bilginin sürekli olarak nasıl kullanıldığı konularına odaklanır. Bilgi haritalama bilgi parçacıklarını birleştirerek ilave bilgi yaratmak olarak tanımlanmaktadır. Bu çalışmada uçuşlara ilişkin olan bileşenlerden pilotlarla ilgili hususlar dikkate alınmış ve problem sahaları tesbit edilmiştir. Çalışmanın sonunda standardizasyonu sağlamak ve uçuş emniyetini arttırabilmek için pilotlara ilişkin her türlü problemi saf dışı bırakabilecek, pilotların havacılık bilgi seviyelerini geliştirecek bir bilgi haritası modeli önerilmiştir. Bu husus pilotların bilgiye daha hızlı fakat düzenli ve doğru bir şekilde ulaşabilmelerine olanak verecek ve pilotların hangi bilgiye ihtiyaç duydukları, hangi bilgiye sahip oldukları ve bu bilgileri nasıl kullanacakları konularında, pilotların bilgileri anlama yeteneklerini ön plana çıkarması açısından en önemli bir husus haline gelmiştir.

Bu konuya ilişkin olarak tesbit edilen başlıca faydalar 1) Pilotun yoğun faaliyetinin yanı sıra enformasyon ve bilgi toplama zahmetinden kurtarılarak tasarruf edilen bu zamanı esas görev hazırlıklarına yönelik faaliyetlere ayırmasına imkan yaratmak
2) Bütün karar vericilere zamanında havacılık enformasyonu sağlayarak bir karar destek aracı oluşturabilmektir.

Bu araştırmanın esas amacı havacılara pilotlar için bilgi, tecrübe ve alınan dersleri paylaşabilecekleri bir bilgi haritası modeli oluşturma konusunda destek vererek girişimlerin hayata geçirilmesini sağlamaktır. Bilgi haritaları ile pilotların bilgi toplamada harcadıkları zamanı kısaltmak, kompleks olan süreci basitleştirmek, havacılıkla ilgili olarak zamanında meteoroloji, teknik ve bakım bilgilerini ve havacılık bilgi kaynaklarını pilota ulaştırmak suretiyle her seviyede karar verme pozisyonunda olanlara bir karar destek aracı sağlamak amaçlanmaktadır.

Bu tez bilgi haritalarını, bilgi haritalamayı, bilgi haritasında olması gereken havacılık bilgilerini, bir çok ülke mensubu pilotlar üzerinde çalışma ortamlarında yapılan gözlemleri ve yapılan iki ankete ilişkin çıkarımları, bazı haritalama yazılımlarının incelemelerini, bunların karşılaştırmasını ve son olarak da Freemind yazılımı ile üretilmiş bir model örneğini kapsamaktadır.

1. INTRODUCTION

1.1. Objectives of the Research

The over all objective of the research is to support civil and military aviation initiatives to create an efficient knowledge map strategy model as a source or knowledge flow for pilots; to create a knowledge exchange map strategy model for pilots which includes subjects, lectures, topics, electronic data links, articles, manuals, technical books and aviation publications; to provide pilots with the correct aviation knowledge to fulfil all kinds of flights safely and successfully in both national and international environments.

In order to pursue and manage these results, the specific objectives of the research are the following: 1) easy visual access by independent users to the data, information and knowledge. 2) to reach tacit information related to a knowledge subject.
3) visual access to knowledge on a specified subject. 4) to enable research in the whole knowledge net. 5) to encourage the repetition of knowledge-use to save time. 6) to install bridges in order to allow knowledge-sharing. 7) to improve access to critical knowledge. 8) to create a knowledge architecture. 9) to create a common memory. 10) to improve learning opportunities and increase knowledge.

1.2. Benefits of the Research

Information and IT provide for pilots timely availability of aviation knowledge, in customizable views, which allows beter decision-making, and therefore safer execution of flights and standardized capabilities. The implementation of web-based portals for virtually all personel-type actions in aviation companies and the units the road for change along these lines by successfully demonstrating the benefits of this technology. The majority of the stakeholders involved are sufficiently technologically able to recognize that an automated comprehensive system will be

beneficial and is inevitable for aviation. With a knowledge map, a pilot is provided with the correct aviation knowledge to fulfil all kinds of flights safely and successfully, in both national and international environments, and information can be exchanged to create a knowledge source or knowledge flow for pilots. The challenge is more in selecting the optimal solution rather than incurring the costs and frustrations of iterating through solutions to find the best solution. The overall driving factor for a technology solution is based upon the human factors of the existing system. A solution that pilots believe will make their jobs easier, safe and more efficient, will be a well-received solution.

1.3. Justification of the Research

- **Relevance of the Issues to the Objectives of the Research:** Knowledge maps, beyond transformation and automation of existing aviation transactions, is the creation of new processes and new relationships between the military aviation units / civilian airline companies and the pilots.
- **Relevance of the Issues to the Priorities of the Model:** Gathering various stakeholders on a knowledge map model with the goal of mapping the current state of aviation knowledge in the organisation, the issues and problems surrounding its advancement, and knowledge on mapping strategies can lay the foundation for future endeavours and collaboration between the also realising bigger goals of aviation reforms.
- **Identification of Perceived Needs and Constraints in the Target Groups:** An information-friendly environment that supports enduring availability, diversity and affordability of aviation-related products and services. It features aviation authorities allowing equal and transparent access to public domain information in the interests of service. The knowledge map that will result from the proposed model can be a mechanism for this continued sharing and cooperation.
- **Limits of the Research:** This research has been centered on pilots. It is aimed to create a knowledge map strategy model for civilian and military pilots.

- **Reliability and Accuracy of the Research and List of Target Groups:** The target group of this research is aimed at pilots who have been educated and trained mostly in military flying schools. This fact is valid for the study of both national and foreign pilots. But aviation rules are standard and are used in different environments. Pilots included in the research are Turkish (92) American (12), British (4), Dutch (20), German (34), Czech (4), Portuguese (14), Italian (9), Spanish (23), Greek (7), Polish (5) and Belgian (3). There are a total of 227 pilots. They all follow on standard universal aviation rules. The civilian pilots are from Turkish Airlines, Onur Airlines, Pegasus Airlines and Atlas Jet Airlines. Aircraft categories the pilots are flying also cause some differentiation in the pilots' requirements and also the flying environments. Civilian-military, transport-fast jet, fixed wing-rotary wing, ground attack-air defence, charter-regular categories assembling under the same umbrella for providing knowledge: all need to have very wide variety of knowledge of the system. But airspace comply with the strict rules of universal aviation, even though they have different levels, aircraft and working conditions. This gives a common understanding among pilots and partnership in the sky.

1.4. Methodology

An essential part of the research is to provide an initiative for a more efficient, effective and transparent delivery of aviation knowledge and aviation support services, through the sharing of experiences and knowledge on operation strategies among aviation companies and military aviation. Secondly in order to find out how to create a knowledge map to help pilots overcome the difficulties in knowledge sharing, an investigative methodology was used for the research. This included articles, manuals, publications, theses, questionnaires completed via Internet and personal interaction with foreign and national pilots. Additionaly the opportunity was taken to share ideas and make observations on the workstations in the Turkish Airlines Training Centre, Onur Air Company, in NRDC-T with foreign pilots and during the Isaf -7 Mission to Afghanistan with Spanish, German, Dutch and American Flight Units.

Reasons for the methodology are to clarify the roles and responsibilities of all national and international aviation organisations, and to define and identify the operational and technical, requirements of the model.

1.5. Definition of the Research Problem

There are deficiencies in aviation knowledge-source management. There are new challenges in knowledge-exchange for pilots. It is necessary to find out what pilots` needs are, then draw a logical model which links those needs. This would be the basis of an intuitive system. There are plenty of adequate methodologies to achieve this. The problems are conflicts arrising from too much information, changing too quickly, and too little space and time.

- How should a pilot be provided with the correct aviation knowledge in order to fulfil all kinds of flights safely and successfully in both national and international environments?
- How can information be exchanged to create a knowledge source or knowledge flow for pilots?

1.6. Beginning Study for Research

The knowledge which identifies the problem from the problem area, had been sellected and the research problem had been identified. The elements of the research were defined as follows.

1.7. Elements as Source of Knowledge for the Map

- Books, forms, electronic documents, reports, maps, voice and visual records are easily reachable for the pilots via a software application or web portal.
- A software application or web portal designed for pilots makes their planning easier, reliable and accurate.
- Fast and accurate knowledge flow helps pilots during flight planning.
- Fast and accurate knowledge flow helps pilots during flight execution.

- Buildings and facilities used for flight purposes make the pilot's flight preparation and flight execution easier.
- Aircraft categories and types cause different knowledge requirements for pilots of different nationalities.
- Aircraft categories and types create different knowledge requirements for different sources and category pilots.
- Pilots' experience, feelings, ideas and accidents for flight subjects are being documented in order to inform other pilots in their knowledge management system.
- Maintenance and repair units are creating technical documents to improve flight safety.
- Assisting sub-units to pilots for flights, flight safety agencies, meteorology, flight operations, ground services all provide service to the pilots via a knowledge-management system.
- ICAO, JAA, FAA or national rules are used in the all flights.

1.8. Demography of the Participants for Research:

- Turkish civilian pilots.
  - Charter pilots.
  - Regular line pilots.
- Military pilots.
  - Turkish pilots
  - Foreign pilots
    - American pilots.
    - Belgian pilots
    - British pilots.
    - Czech pilots.
    - Dutch pilots.
    - German pilots.
    - Greek pilots.
    - Italian pilots.
    - Polish pilots.

- Portuguese pilots.
- Spanish pilots.
  - Army Aviation pilots.
    - Fixed-wing pilots.
    - Rotary-wing pilots.
  - Air Force pilots.
    - Fixed-wing pilots.
      - Air defence pilots.
      - Fast jet pilots.
      - Ground-attack pilots.
      - Transport pilots.
    - Rotary-wing pilots.

1.9. Pilots' Knowledge Map Variables

a. Knowledge exchange model can be done to create a knowledge source or knowledge flow for aviators, especially for pilots, depending on the nature of the flying. For aircrew flying from well-established bases, a knowledge map could be very effective.

b. Concerning the category of the books, manuals, publications, journals, web sites or electronic data links it is recommended that for pilots to be prepared for any kind of flight, they need to use military/civil regulations for flying, flying techniques for types of flight, aircraft type manuals and regulations, engineering manuals, ATC publications, NOTAMs, Meteorology, Airfield data.

c. Pilots use military regulations, civil aviation charts, military and civil mapping, electronic and paper data for flight systems in order to fulfil a flight mission.

d. Pilots think that a full-motion simulator is the best choise for emergency procedure practice.

e. Pilots use electronic flight-planning support systems (Electronic and Manual) in order to be prepared for any kind of flight.

f. Pilots use, for flight planning; maps, GPS and navigation system preparation to be ready for any kind of flight.

g. Aviation knowledge sources should be available for all pilots on an electronic system, and it needs to be available by intuitive selection.

h. As a pilot, greater sophistication, more aircraft systems and greater complexity remove the pilot further from the basic machine: when these systems fail, the amount of knowledge that has to be retained mentally has increased significantly.

i. In order to prepare a knowledge map model for pilots you'd ask to the pilots what their needs are then draw a logical model which links those needs. This would be the basis of an intuitive system.

j. All aircrafts can operate in airspace that is why there are some additional air trafic like OAT which are more related to the national aviation rules. So pilots have to be provided with also national rules besides ICAO rules.

k. The knowledge should flow with interaction between the some components like meteorology, ICAO, Jar, Millitary, Legal, Technical and the responsible aviation agencies like governmental agencies, updated as it is required and presented to the pilots via a comphrehensive knowledge map it also should include a wise page and mailing tool.

1.10. Model of the Research

There are deficiencies and new challenges in aviation knowledge source management in knowledge exchange for the pilots. It is important to find out what pilots` needs are then to draw a logical model to link those needs.
That is why first in my model the requirements and the problems in this area were analysed. This would be the basis of an intuitive system.
After requirements were identified then the subjects, lectures, topics, electronic data links, articles, manuals, technical books, aviation publications were selected.
Then comparison and evaluation of the knowledge in the model took place. Variables were identified as the basis of the questionnaire evaluations; later these variables were used for evaluating the questionnaires.

Books, forms, electronic documents, reports, maps, voice and visual records were included in the research, that are easily accessible via a software application or web portal for rotary-wing and fixed-wing pilots. Facts and the aviation process were researched for the model. In seeking to identify how could this be done, observation was made of pilots in different environments, to understand their work process and the differences between them. Then later in the model of research questionnaires were prepared to get more knowledge from a greater number of pilots. Following this step, knowledge, necessary for the pilots was obtained for the model. This led to the questions of how the knowledge can be made available by intuitive selection in a knowledge map model, and how the flow of knowledge in the system can be made efficient. Software applications were investigated to find out which best fulfilled this task, and a selection was made to answer all requirements in a proper and efficient way.

1.11. Hypothesis of the Research

H1: The use of knowledge maps for pilots makes it possible to meet pilots' knowledge requirements in their planning and the execution phases of flight in order to conduct efficient, successful and safe flights, continuously updated, accurately and fast, with a high reliability.

H2: The use of knowledge maps for pilots does not make it possible to meet pilots' knowledge requirements in the planning and execution phases of flight in order to conduct efficient, successful and safe flights, continuously updated, accurate and fast, with a high reliability.

Statistical and mathematical methods in evaluation of the hypothesis were used. Questions which took place in questionnaires were not random ones. These were extracted from the aviation sources. That is why an expected result was obtained. In conclusion H1 has been accepted and H2 has been rejected.

1.12. Identification of the Necessary Knowledge Types, Sources and the Knowledge Collection Method and Examining

The necessary knowledge types, sources and the collection methods have been identified:

- First the required knowledge.
- Secondly the testability of the knowledge with the methods of analysis.
- Third the knowledge was systematically collected for the research. As collection methods; observations, questionnaires, literature research and the interviews were used.
- In the first questionnaire open ended questions were used and in the second one multiple choice questions which make it easier to understand the requirements of the different categories of pilots.
- Dimensional seperation measurement method has been used in examining.

In the evaluation of the questionnaire dimensional separation method was used. 11 multiple choice questions were taken into consideration here. The following results were concluded using the dimensional separation method:

Values starting from 1 to 7 accordingly to each answer (starting from wrong :1 to absolutely correct :7)

Table 1.1 : Average Value Table for Knowledge Map Model of Pilots

												Test Subject	Average
Weight →	11	10	9	8	7	6	5	4	3	2	1		
↓ Questionnaire 2	a	b	c	d	e	f	g	h	i	j	k		
1	80	42	0	8	0	5	1	1	1	1	1	140	10.06
2	75	40	15	4	0	11	1	1	1	1	1	150	9.82
3	72	43	27	0	3	1	3	1	7	1	1	159	9.65
4	95	32	18	0	0	1	1	1	1	1	5	155	10.01
5	52	3	49	0	14	1	2	1	6	1	1	130	9.09
6	47	33	25	0	36	1	1	1	1	1	1	147	9.15
7	60	42	35	8	0	4	1	1	1	8	1	161	9.39
8	62	38	44	1	0	1	1	5	1	1	1	155	9.70
9	58	28	32	25	3	1	2	1	1	9	1	161	9.12
10	24	32	48	34	7	1	1	1	1	1	1	151	8.99
11	84	32	25	0	4	1	4	1	1	1	1	154	9.95

This conclusion has been evaluated by the group which the questionnaire examined. Average value for the calculations shows that the pilots who participated in the questionnaire decided as in general evaluation value is as correct for analysis. This is a technique which helps evaluation where many variables exist. A total of 161 questionnaires were evaluated. From the questionnaires 11 variables have been selected for the analysis. These variables have been selected according to the answers given to the questions.

Table 1.2 : Corellation Matrix for Knowledge Map Model of Pilots

Variable	a	b	c	d	e	f	g	h	i	j	k
a	1.00										
b	0.29	1.00									
c	-0.70	-0.52	1.00								
d	-0.62	0.00	0.29	1.00							
e	-0.47	-0.35	0.16	-0.14	1.00						
f	0.25	0.37	-0.50	-0.08	-0.31	1.00					
g	0.27	-0.17	0.05	-0.22	-0.07	-0.34	1.00				
h	-0.04	0.14	0.34	-0.18	-0.19	-0.16	-0.21	1.00			
i	-0.04	-0.37	0.27	-0.31	0.09	-0.24	0.44	-0.15	1.00		
j	-0.14	0.06	0.15	0.42	-0.20	-0.02	-0.05	-0.15	-0.22	1.00	
k	0.51	-0.03	-0.24	-0.21	-0.19	-0.16	-0.21	-0.10	-0.15	-0.15	1.00

With the variables a correlation matrix for knowledge map model was created and the corellation between the variables can be seen in the above table.

1.13. Exampling Process

1.13.1. Defining the Main Target Group

The group has both civilian and military pilots. Military ones are army aviation and air force pilots.

Foreign pilots included in the research are American, British, Dutch, German, Czech, Portuguese, Italian, Spanish, Greek, Belgian and Polish.

The Civilian Pilots are from Turkish Airlines, Onur Airlines, Pegasus Airlines, Atlas Jet Airlines.

Aircraft types that pilots fly cause some differentiation in the pilots' requirements and also flying environments.

Civil-military, transport-fast jet, fixed-wing, rotary-wing, air defence-ground attack, charter-regular line categories are the main target groups for the research.

1.13.2. Identification of Main Example Frame and Example Individuals

The pilots have been the sampling individuals for the research that they are the including almost the similar groups from the target list. The individuals that exist in the pilot groups have been sampled equally in order to avoid systematic errors.

1.13.3. Identification Exampling Method

Group sampling has been used as a method for research. The knowledge, which will be the product, is for some reasons not identical, which is why this method has been used.

1.13.4. Identification Exampling Scale

If the sampling area is very big then it is possible to obtain some more realistic conclusions. The majority of the samples in finding out answers to the research problems were used.

2. KNOWLEDGE MAPPING

2.1. Explanations and Descriptions

Knowledge is an interesting concept that has attracted the attention of philosophers for thousands of years. In more recent times, researchers have investigated knowledge in a more applied way with the chief aim of bringing knowledge to life in machines. Artificial Intelligence has provided some degree of rigour to the study of knowledge and Expert Systems are able to use knowledge to solve problems and answer questions. Current business, social, political and technological pressures have forced organisations to take greater control of the knowledge asset. Software suppliers and others offering valuable solutions in this area have unfortunately clouded the issue of knowledge. Information and data control are seen as implicit knowledge management tools and many have abandoned the search for explicit knowledge management methods.

Knowledge representation schemes help to identify knowledge. They allow for human understanding and machine application and they can support the automated use of knowledge in problem solving. Some of these representation methods also employ spatial techniques that add an extra dimension to human understanding. Knowledge mapping defined in this work uses learning dependency to organise the map and draws on the ideas of what knowledge is and on spatial representation structures. Knowledge maps can support metrics that provide information about the knowledge asset. Knowledge maps create a visible knowledge framework that supports the explicit management of knowledge by organisation managers and directors. Knowledge maps also offer other advantages to the organisation, the individual and to educational institutions [1].

Knowledge Maps are systematically developed navigation tools, which may represent an organization’s explicit and tacit structures of knowledge. They can refer to databases, documents and knowledge gathered by experts and teams.

They are eithersignposts containing meta-information or refer to it. It is generally understood that the knowledge maps identify the location of knowledge in an organization but knowledge maps also structure the knowledge. Intellectual capital today has great importance in organisations, but very few of them draw, from the picture of knowledge, pools of talent and expertise.

2.2. Knowledge Maps

What is a knowledge map ?

A knowledge map is a tool that searches the explicit and tacit knowledge and shows the relation between knowledge deposits and dynamics. It also shows its importance. A knowledge map is a study that deals in knowledge, particularly locations, owners, value and how it is being used in organisations, the roles of the members and expertise of an organisation, expertise fields, the limits of knowledge flow, and increasing the quality of existing knowledge [2].

Knowledge mapping is an important application which consists of research, inspection and synthesis functions. The aim of this application is to track imported information, knowledge and lost knowledge. Thus, knowledge maps identify the expertise and competence of individuals and groups in organisations.

It also helps in the visualisation of knowledge flow in organisations. Knowledge mapping turnover on intellectual capital, helps in identification of project teams in the most efficient way and tracks the appropriate technology in knowledge requirements and processes.

Knowledge Map Types :

Topic Maps : The map shows and models the relationship of the knowledge with information sources. Topic maps show the relations between the topics, human being in the organisation, products, duties. [3]

Resource Maps: The maps link the knowledge requirements with knowledge sources.

Mind Maps : Organises the knowledge in a logical way and presents it.

Knowledge Network Maps : It identifies the knowledge gaps and maps it. It identifies the key persons who difussed the knowledge.

Competency Maps : These maps document the person's talent, position, and carier ways.

File Structured Maps : They show the relations of explicit knowledge

Social Network Maps : It shows effects between the organisation members, organisations and the social groups.

Knowledge Mapping Tools : There is no standardisation in these tools. Different tools map the knowledge in different ways and each has own approach in mapping.

2.3. Advantages of Knowledge Mapping

The main aims for a knowledge map of an organization are as follows.

- The access of independent users visually to data, information and knowledge.
- To see the hidden information related to a certain set of knowledge.
- To access all information related to an object when it is searched specifically.
- To create new knowledge in order to expand the knowledge base.

2.4. Creation of the Knowledge Map

The transfer of produced, learned and used knowledge in an organisation to a knowledge map requires a comprehensive and detailed project work. That is why top management support to a such project is a must. Besides this, even in the beginning phase, the project team has to be aware of the explicit and tacit knowledge elements such as, what they are, how they are being processed and diffused in the organisation. The project team members should be from the different departments of organisations. They should have knowledge of the work processes, required experience of the subjects and work expertise.

2.5. Basic Principles

Basic principles of knowledge mapping implementation are as follows:

- There should be top-management support for knowledge mapping.

- Knowledge mapping limits should have been defined for the project.
- Knowledge in the organisation has to be identifed and grouped in different locations as explicit, tacit, formal, informal, institutional, personal, interior, exterior, temporary existing, short-life and long-life.
- Knowledge maps should contain processes, relations, policies, personel, documents, communication channels, links, suppliers, competitors and customers.
- The knowledge mapping process should be done accordingly to organisational structure, level of developement and values; cultural problems and sharing capabilities of employees. Business secrets, patents and trade marks have to be protected during mapping, the team should avoid exposing these critical issues. [1]

2.6. Knowledge Mapping Process

2.6.1. Beginning Requirements and Information Collection

Requirements come out during project should be answered in time and in a better way for the success and efficiency of the mapping.
What are these requirements?

- To have managers support for the project.
- To have the permission of access to the knowledge or knowledge source .
- To have an comprehensive work environment.
- To have communication channels in order to collect the knowledge.
- To have the environments in order to store the collected analysed knowledge.
- To have the knowledge and talent for data analysis and statistics.
- To analyse the knowledge types in order to fullfil the projeet.
- To know the knowledge source and access method.
- To create additional value.
- To identify the end state.
- To identify the way competent knowledge flows in the organisation.
- To identify the obstacles which limit better access to knowledge in the organisation.

- To find an easier way for knowledge exchange.
- To identify the problem solving methodology.

The project will be succesful when this requried knowledge is identified at the beginning. This also give the logical flow of the project. In any step of the project there may be some additional requirement: the project team should work on these new requirements and solve the problems that arise. [4]

Knowledge will be Collected:

The project team starts with classification of the knowledge that exists in the organisation for mapping. After completing the classification, the knowledge existing in the organisation is to be collected accordingly to the classes.

The knowledge classification and collecting the knowledge related to classes will show us our capital: it is clear that the organisations which don't have an comprehensive knowledge treasure will have many problems in their work processes. In that position the knowledge producers can exist outside the organisation. If it is necessary to import or transfer this knowledge to the organisation, then particularly difficult to access these sources. The method for transferring can be almost the same method used in identifying the knowledge in your organisation as previously discussed.

The basic knowledge objects in an organisation can be listed as below.

- **Organisational Knowledge**
    - Organisation's functional areas
    - Organisation's history
    - Knowledge related to the organisation.
    - Geographic location of the organisation.
- **Strategies and Policy of the Organisation**
    - History of organisation

- Functional areas of organisation
- Mission of the organisation
- Vision of the organisation
- Organisation's values
- Organisation's long term-short term targets.
- Operations to reach long term and short term targets.

Systems :

'Systems' includes the sub units in organisations, their operations, authority and responsibility shares, job descriptions etc...

Employees :

The knowledge related to employees in the organisation should be included in the knowledge map. These can be counted as below

- Personal knowledge,
- Autobiography,
- Work expriences,
- Expertise subjects
- Personal success

Relationships:

The knowledge map should include the formal and informal institutions and organisations that have a relationship to the organisation being studied. [5]

Permissions:

Official permission certificates, patents and licences' knowledge also should be included in the knowledge map.

Plans and Operations :

Operations, oparational processes and projects knowledge that occur in the services of organisations also be included in the knowledge map.

Contingency Plans :

The knowledge related to extraordinary conditions, and the precautions and the contingency plans for these conditions should be included in the knowledge map. Safety issues related to accidents also should be inserted to the maps. Lessons learned from these expriences will be included for benefits of members.

Thoughts and Observations :

Individual expriences, ideas, feelings of the organisation members related to some important issues also should be included in the knowledge maps.

Process Knowledge Maps :

Process knowledge maps show work processes. They show which knowledge is being used and how that knowledge flows in the processes. The knowledge required before the process, knowledge used during the process and the knowledge created after the implementation of the process can be mapped.

Process knowledge maps show answers to the following questions:

- What knowledge is required?
- Who owns the knowledge?
- Where does the knowledge reside?
- Is this knowledge explicit or tacit?
- Is the knowledge used regularly?

Process knowledge maps are tools which aid in structuring the work process. The maps identify the knowledge required before the work process begins, pinpoints knowledge used during the process and finally maps the knowledge created upon culmination of the process. As a result, process knowledge maps show knowledge flow and which knowledge is actually used for the processes. [6]

3. KNOWLEDGE MAPPING FOR PILOTS

3.1. General Knowledge About Aviation

Aviation is expanding, and this expansion is expected to continue for the foreseeable future. More people want to fly, and aircraft types are increasing in number. Technical innovations and automation introduce changes in the control of aircraft as vehicles and as traffic, and in the numerous human roles and jobs in the air and on the ground that support aviation. The domain of human factors as a discipline is also expanding, independently of aviation. It now embraces more topics and applications than it formerly did, and employs a greater variety of techniques.

The rapid and sometimes revolutionary developments in technology, aviation, and human factors, and the complex interdisciplinary interactions between them, lead to a requirement to review and appraise progress from time to time by taking stock of what has happened and by peering into the future. The greatest problems with early flight were the reliability of the propulsion system and the strength and stability of the airframe. Many accidents and some fatalities occurred because of the structural failure of an airplane component or the failure of the engine to continue to produce power. [7]

The improvement of the human-machine interface was largely an undertaking of the designers, builders, and fliers of the machines (the pilots themselves). They needed some critical information to ensure proper control of their craft and some feedback about the power plant. At first, the aircraft did not have instrumentation. The operators directly sensed the attitude, altitude, and velocity of the vehicle and made their inputs to the control system to achieve certain desired goals. The advantages of an aerial view and ability to drop bombs on ground troops from above gave the airplane a unique role in the First World War. Although still in its infancy, the airplane made a significant contribution to the war on both sides, and it became an object of wonder

while thousands aspired to become aviators. The roles of the airplane were principally those of observation, attack of ground installations and troops, and air-to-air aerial combat. The aircraft themselves were strengthened to take the increased G-loads imposed by the combat maneuvering and the increased weight of ordinance payloads.

The major human factor problems of the World War I era were the selection and classification of personnel, the physiological stresses upon the pilots, and the design of the equipment to ensure mission effectiveness and safety. The military airplanes developed after World War II were principally jet fighters and bombers. The inventory was "mixed" with many of the piston engine airplanes being left over, but as the United States approached the Korean War the jet aircraft became the prominent factor in military aviation. Just before World War II, Igor Sikorsky developed a successful helicopter. During the Korean War, the helicopters found widespread service.

With the advent of the microcomputers and flat panel display technologies, the aircraft cockpits of the modern airplanes are vastly different from those of the past. The navigational systems are extremely precise, and they are integrated with the autopilot systems for the capability of fully automated flight from just after take-off to after the airplane touches down on the runway. The pilot is becoming a passive observer of the airplane's systems while the automation does the flying. A challenge for the designers is what to do with the pilot during the highly automated flight.

Rapid advances in software and hardware have provided the capability to develop very complex systems that have highly interrelated components. Although this has permitted significant increases in system efficiency and has allowed the development and operation of systems that were previously impossible.

3.2. General Requirements

The knowledge system should be unobtrusive to the primary mission of the aviation unit or company; this includes minimizing the training required to use the system, minimizing the complexity, and adding value to the immediate user and higher echelons through increased availability of knowledge. In order to minimize training, the data entry component of the system should bear a strong resemblance to

historical data entry tools and formats. The input process should follow an intuitive natural flow and capitalize on the user's familiarity with existing internet-based information systems. Maintenance and support of the knowledge system should be centralized in non-combat areas, either in one location or possibly in a few regional locations. A single data input source should serve all of the flight company requirements. The same flight data should generate the aircrew and maintenance reports without requiring additional human interface to transfer or copy the data. At some level the data system will need to interface with the existing aviation authorities' automation systems.

3.3. ICAO

In December 1944, a convention was held in Chicago, USA, to set up international standards and agreements for operating procedures and navigation. This was initially attended by 52 nations and over the last 50 years has grown in number to include practically every state worldwide. Today the ICAO has its headquarters in Canada (Montreal) and oversees the development of "standards" and "recommended practices" which are then legislated for at national level by member states. The ICAO has published a number of "annexes" which relate to various aspects of aviation [8]. These include:

Annex 1 Personnel Licensing
Annex 2 Rules of the Air
Annex 3 Meteorological Services for International Navigation
Annex 6 Operation of Aircraft
Annex 7 Aircraft Nationality and Registration Markings
Annex 8 Airworthiness of Aircraft
Annex 9 Facilitation
Annex 11 Air Traffic Services
Annex 12 Search & Rescue Services
Annex 13 Aircraft Accident Investigation
Annex 14 Aerodromes
Annex 15 Aeronautical Information Service
Annex 17 Security
Annex 18 Transport of Dangerous Goods by Air

3.4. Official Certificates for the Pilots in order to Conduct Flights

Certification can be thought of as the legal aspect of verification and validation: that is, it is verification and validation carried out such that a regulatory body agrees with the conclusion and provides some "certificate" to that effect. The concept of the certification of aircraft and their pilots is not new.

For many years the engineering and mechanical aspects of aviation systems have had to meet certain criteria of strength, durability, and reliability before they could be certified as airworthy. Additionally, pilots of aircraft have to be certified on their flight skills and must meet certain medical criteria. However, these components (the machine and the human) are the tangible aspects of the flying system, and there remains one more, a less readily quantifiable entity the interface between human and machine [9]

The organizations involved cover the entire range of aviation organizations, from airline operations departments to airports, manufacturing organizations, air traffic control, and corporate flight departments. Organizational factors include such things as organizational structure, management, corporate culture, training, and recruitment. [10]
All aviation organizations learn from experience. How well they learn is another matter. In the aviation community learning from mistakes is critical because failure of even a subsystem can be fatal. Because aircraft parts are mass-produced, what is wrong with one plane may be wrong with others. Systematic error, then, must be detected soon and rooted out quickly. Compared to other transport systems, aviation seems to have a good system for making such errors known and corrected quickly

3.5. Simulators

Simulators may be an ideal environment for implementing scenarios for training, but the costs often limits their availability for anything other than technical training. Role-play scenarios can be designed where no equipment is used, but they lack many necessary task cues and can not require the crew to perform additional duties and tasks that are part of an aviation team's job.

Low-profile trainers can provide an environment where some of the task cues can be included, and this can be done economically. [11]

A number of experiments have been conducted with aviation team members (cockpit crews and maintenance team members) that have used a low-profile system for the practice of teamwork. Low-profile flight trainers can be built with off-the-shelf aviation programs, a personal computer, and simple peripherals. They are enhanced by realistic scenarios designed with the physical limitations of the systems in mind. The secret to the acceptance of these systems is carefully constructed scenarios and realistic application.

3.6. Medical Surveillance

Good medical surveillance is essential to ensure that operators are in good health and able to carry out their job without excessive stress and performance impairment. Besides careful application of ICAO precise norms and recommendations for the medical certification of license holders, medical checks should be oriented toward preserving physical and mental health with regard to the temporal organization of body functions.

In the light of the possible negative consequences connected to desynchronization of the biological rhythms, both selection and periodical checks of workers engaged on irregular work schedules should take into consideration some criteria and suggestions proposed by several authors. Work at night and on irregular shift schedules should be restricted for people suffering from severe disorders that are associated with or can be aggravated by shift lag and jet lag, in particular, important gastrointestinal diseases (e.g., peptic ulcer, chronic hepatitis, and pancreatitis); insulin-dependent diabetes, as regular and proper food intake and correct therapeutic timing are required; hormonal pathologies (e.g., thyroid and suprarenal gland). Because they demand regular drug assumption strictly connected to the activity/rest periods; epilepsy, as the seizures can be favored by sleep deprivation and the efficacy of treatment can be hampered by irregular wake-rest schedules. Chronic psychiatric disorders, depression in particular, as they are often associated with a disruption of the sleep/wakefulness cycle and can be influenced by the light/dark periods.

Chronic sleep disturbances; and coronary heart diseases, severe hypertension, and asthma, as exacerbations are more likely to occur at night and treatment is less effective at certain hours of the day. Workload within most categories of aviation work has been increasing since aviation began. In the earliest days, aircraft were pushed to their limits and aviation operations were limited. Pilots flew the airplane from one place to another. To examine the selection and training of pilots, it is best, as with all such issues, to begin with the requirements. [12]

3.7. Automation in Aviation

As the design of crew stations evolves, the tasks necessary to successfully complete the mission are being identified. To relieve workload problems, these tasks must be divided between the pilot and computer, and an optimum balance should exist between the two. As shown by researches within the artificial intelligence community, the on-board computer, or electronic crewmember (EC), is becoming more capable of accomplishing tasks for the pilot. The issue now centers on how much automation is optimum. Issues of automation, the teaming of the pilot with the EC, and team trust in the flight environment are very important. [10]

The military flight environment faces some unique circumstances not encountered in the civilian flight arena. The fighter/attack aircraft, with one pilot, flying very low, and attempting to locate a target at night, in adverse weather conditions, is one of the most difficult cases. Under these circumstances, automation becomes a key enabling technology, but questions such as, "What functions should be automated?" and once decided, "Can they be automated?" must be answered before automation can be successfully employed.

3.8. Assisting Sub-Units to Pilots for Flights, Work Done by Sub-Units

3.8.1. Air Traffic Control

The primary function of an air traffic control (ATC) system is to keep aircraft participating in the system separated from one another.

Secondary reasons for the operation of an ATC system are to make more efficient use of airspace, and to provide additional services to pilots such as traffic information, weather avoidance, and navigational assistance. [9]

Not every aircraft may be required to participate in an air traffic control system, however. Each nation's regulations only oblige certain aircraft to participate in the ATC system. ATC participation in each country may range from mandatory participation of all aircraft, to no ATC services offered at all.

The level of ATC services provided is usually based on each nation's priorities, technical abilities, weather conditions, and traffic complexity. To more specifically define and describe the services that can be offered by an ATC system, the International Civil Aviation Organization (ICAO) has defined different aircraft operations and classes of airspace within which aircraft may operate. Different rules and regulations apply to each type of aircraft operation, and these rules vary depending on the type of airspace within which the flight is conducted. Although ICAO publishes very specific guidelines for the classification of airspace, it is the responsibility of each country's aviation regulatory agency to categorize its national airspace. [13]

3.8.2. ATC Services

Airspace with little or no potential traffic conflicts requires little in the way of sophisticated ATC systems. If air traffic density increases, if aircraft operations increase in complexity, or if special, more hazardous operations are routinely conducted, additional control of aircraft is usually required to maintain an acceptable level of safety. The easiest method of defining these increasing ATC system requirements and their associated operating rules is to define different classes of airspace within which different ATC services and requirements exist.

Standard ICAO airspace classifications include classes labeled A, B, C, D, E, F, and G. In general, Class A airspace is positive controlled, where ATC services are mandatory for all aircraft. Class G is uncontrolled airspace where no ATC services are provided to either IFR or VFR aircraft. Classes B, C, D, E, and F provide declining levels of ATC services and requirements. [9]

It is each nation's responsibility to describe, define, explain, and chart the various areas of airspace within their respective boundaries. In general, areas with either high-density traffic or a mix of different aircraft operations are classified as class A, B, or C airspace. Areas of low traffic density are usually designated as class D, E, F or G.

3.9. Information and Knowledge Models for Aviation

Although modern avionics possesses considerable data, it is difficult to identify which data is actually information (data of value) to the pilot. As a result, the avionics is limited in its ability to change the information on the displays. Intelligent information management automatically selects the displayed information, its level of emphasis, and its format. There are several reasons for the importance of intelligent information management in a modern crew station. First, there is a tremendous volume of data available. [13]

Current trends in data communication and data storage aboard aircraft promise to increase this volume. Second, most of the data is without value at any one particular time, although presumably all of it can be of value under some circumstances. As a result, the user can spend a considerable amount of time and effort selecting the appropriate data for display.

3.9.1. Representational Needs in Information Modeling

The three representational needs in information modeling are, in order of importance, information need, emphasis, and format. Information need is modeling the information that is relevant in current and near-term situations. Information emphasis is determining which selected information should receive increased display emphasis. Information format modeling is determining how information that is relevant and possibly emphasized should be displayed. The range of display choices includes such dimensions as location, size, color, shape, symbology, and modality. [14]

Information Need. The foremost modeling question is, what gives rise to information requirements? The most obvious requirement for information is task execution, which is described in the intention model. Indeed, one of the traditional uses of task analysis models was to determine information requirements.

Both task analysis and intentional models are top-down methods of determining information requirements. Given such a model, information requirements are associated with tasks or intentions.

The second source of information requirements is significant situational changes, or events. Events are detected by an assessment module that finds the few significant state changes among the many insignificant changes. Events are bottom-up sources of information because they are unanticipated within the intentional structure and are the result of noticing changes to low-level data. Because information requirements arise from two sources, events and intentions combining the information requirements into a single representation of the pilot's complete needs is important to select the right information to display. [15]

There are dozens of dimensions that can be used to describe information. Some examples include the priority, the use (warning, control, checking), and the type (navigation, weather, system). Starting with these dimensions makes the problem of automatic information selection and formatting seem extraordinarily difficult. Experience has been that most of these dimensions are not useful in information management. What has been more practical is to work backward from the decisions to the inputs necessary for those decisions (i.e., need, emphasis, format).

Information arising from intentions and events can be in conflict, in that there may be more information required than fits within the available display area. Further, information requirements arising from a single type of source, such as intentions, can be in conflict with each other. Fundamentally, information selection is a resource allocation problem, and resource allocation usually means that there is competition for resources. Concepts such as priority and importance are essential to resolving these conflicts optimally. [16]

Event based information may or may not be of interest to the pilot at the moment the event is detected. One way to determine whether an event is of interest is to map it onto changes in capabilities of the aircraft: thrust, sensing, navigation, fuel, and so forth. In the intention model, interest in changes in the capabilities can be expressed.

Determining whether there is any interest is simply a matter of looking at the capability concerns of the active tasks.

Information Emphasis. The emphasis function causes certain display elements to be given perceptual attributes that cause their salience to be higher. The exact attributes changed are determined in the format decision, which is discussed later. The emphasis decision merely decides what information should be emphasized, but not how it should be done. The remainder of this discussion on emphasis concentrates on how this decision can be made.

There are numerous reasons why information should be emphasized. One reason is the extreme consequences of not taking into account the information content. An example is failure to complete some item on a checklist, such as setting flaps for takeoff and landing. Another reason is doctrine. For example, current commercial air transport practice is to call out the altitude at 100-ft intervals during landings (in the United States). This information is already available on the altimeter; it is emphasized by a voice callout. In addition to emphasis, this procedure also presumably increases altitude awareness for one crewmember beyond what would otherwise be the case. Emphasis is also required by unusual or urgent events to alert the crew to the unusual conditions and to secure a prompt response to the urgent event. [17]

Correspondingly, representation of the need for emphasis can be included in several places within the models discussed thus far. The most frequent source of emphasis is in significant events. Typically, if an event's information is important enough to display (i.e., to change the displays in favor of this information), then emphasis is also required. Intentions can also serve as a convenient structure on which to associate the need to emphasize, particularly with regard to information that is emphasized due to policy. A third source, not unlike the first, is the error monitor, which monitors for hazardous situations and produces events to notify the pilot. [18]

Information Format. The final decision to be made about information is the display format or modality. This includes selection of modality (Oral, visual, both) and the display element to use (bar chart, digital, tape, etc.).

The motivation behind these decisions is to configure the most directly visible perceptual aspects of the displays to convey information to the user in a way that it is most suitable for its intended use.
This process is most akin to the traditional human factors display design process. In fact, it could be considered an online version of the same. Any of the criteria used in conventional display design are potential candidates for the online version. [19]

Examples Include:
The accuracy with which the information must be perceived.
Whether rates of change of the displayed information are needed.
Whether the information is to be used for a checking or control.
The final shape of the modality selection depends to a great deal on the display flexibility available to it. For example, if there are few display capabilities for varying display of altitude, there is little need to consider it during design. A highly capable information manager can place heavy demands on display generation. In practice the display programming effort has been at least as large as the information management effort. Display flexibility is less of a restriction in selection and emphasis of information because virtually all display generators have some way to perform both of these functions.

It is worth making a few points about visibility and appreciation for various types of functionality. Selection of information is a highly visible function. Its changes are immediately apparent on the display system, and if correct, they immediately give a positive impression. Emphasis, which consists of highlighting visual displays, is less apparent than selection, and formatting is less apparent than either of them. The practical implication of this difference in functionality, or rather this perception of functionality, is that some consideration needs to be given during requirements generation to the perceived value of the various functions.

One criticism of traditional automation is that it takes too much authority and awareness away from the pilot. At first glance, the same claim could be leveled at information management because it controls displays automatically. There are several reasons why this claim does not hold up under scrutiny.

The first reason is that the information manager is intended to improve the pilot's situation awareness by showing information that the pilot would have selected anyway. The pilot does miss out on the reasoning that went into display selection, but the displays selected should make this reasoning evident.
The second reason is that the pilot always has the authority to override the information manager. When this happens, the displays are under manual exclusive pilot control until certain conditions are met. Conditions might be that a certain amount of time has elapsed or the situation has changed significantly. The best condition to use is still an active research topic.

A third reason is that the behavior of the information manager can be adjusted to the domain in a way that does not diminish the pilot's authority. For example, display selection may remind the pilot by placing an icon at the edge of a screen. Automatically replacing one display with another would be reserved for the most immediate and serious problems. One approach to this essential problem is to develop a model of how crewmembers share information and would perform this task for each other. The pilot (the ultimate end user) needs accurate, timely, and appropriate information. Precise information regarding the occurrence, position, and intensity of a weather phenomenon is very important for pilots. A weather detection and dissemination system for this type of hazard should meet these needs and nothing else, for this phenomenon requires immediate evasive action by the pilot. There is no time for interpreting a complex display.

The system or structure that supports the ultimate end user operations, meteorology, air traffic control needs accurate, timely, and appropriate information The information needs for those supporting airspace operations are quite different, from those of the end user.

The weather information must be presented in an optimal form that makes it quickly and unambiguously usable as a decision aid. This requires the system developer to understand the extrinsic as well as the cognitive aspects of each user's task. If the pilots are bewildered with a long, complex alphanumeric Teletype message that is trying to describe a complex, three-dimensional graphic, then it will make their work more difficult.

Pilots think in four dimensions (the fourth being time); decision support information, in most cases, should be presented similarly.

A mechanism should be in place to develop new weather "products" or refine current ones to address new aviation hazards as they are identified. The possible existence of essentially clear air, terrain-induced, extreme severe wind phenomena is a possible situation. History has shown that the scientific community and aircraft operators can work extremely well together to precisely define new hazards, determine how to detect or predict them, and get appropriate information to the end user in time to initiate a proper response.

In summary, to best serve the aviation weather user community, weather observations and forecasts must improve, aviation weather information dissemination must improve, and users of aviation weather must be trained in its proper use, given their functional role. These goals translate into human factors issues that will challenge human factors researchers and practitioners alike.

Knowledge Mapping Matrix for Pilots:

Table 3.1 : Knowledge Mapping Matrix for Pilots [20]

What knowledge is needed?	Who has it?	Who needs it?	Where is it?	Is it tacit or explicit?	Is it routine or non-routine?	What issue(s) does it address?
Engine Turbine Wing Deformation	Aircraft Manufacturer	Aviation Unit	Bell Co. USA	Tacit	Non Routine	Engine Inspection and Change
Tactical Flight Procedures	Aviation Batallion Operations Branch	Aviation Squadron	Kabul	Explicit	Routine	Conduct a workshop
Meteorological Reports	Meteorology Centre	Aviation Company	Airport Atatürk	Explicit	Routine	Reports Especially Icing Levels

Analysis of Process Knowledge Maps:

- Do we use this knowledge?
- Does everyone reach and use this knowledge when it is required?
- Are decisions being taken by using the accurate knowledge?
- Where do we have to focus on during our improvement trials?

In the End of Analysis:

- Strengths are identified.
- The opportunities for developement are listed.

A Second Model for Knowledge Mapping:

Knowledge maps have two components.

- **Diagram:** This is graphical presentation of the knowledge with relations and points.
- **Point :** It is a box which shows the knowledge derived from processes.
- **Relation (link) :** Arrows show the relationship between the knowledge.
- **Properties :** Definition of knowledge.

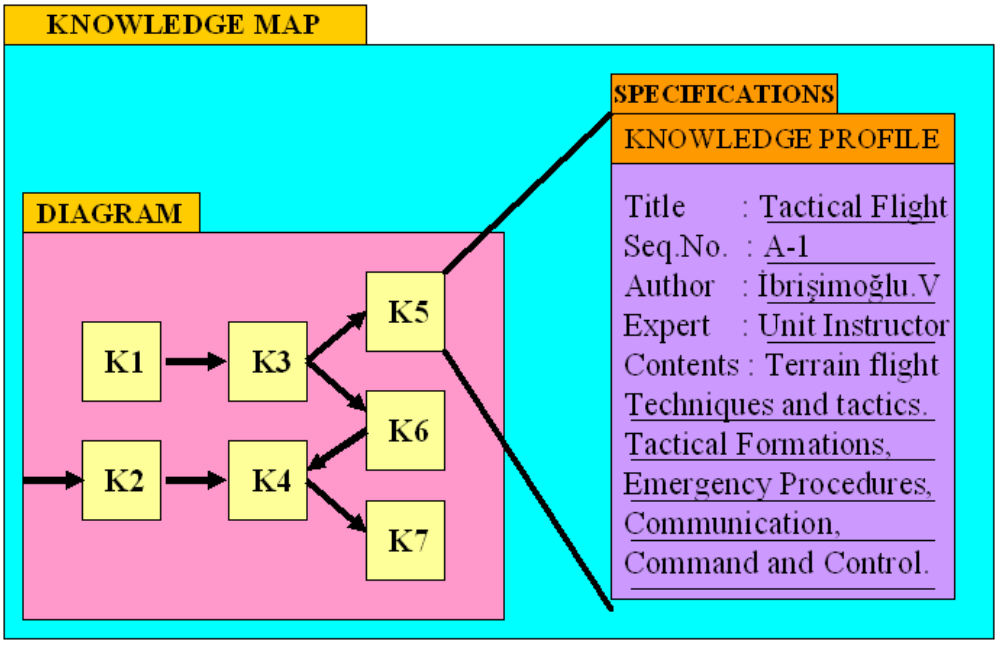

Figure 3.1 : Knowledge Map Diagram [20]

Knowledge Mapping Procedures:

There are 6 steps in knowledge mapping: defining the organisational knowledge, process map analysis, extraction of the knowledge, profiling the knowledge, linking the knowledge, validation of knowledge map.

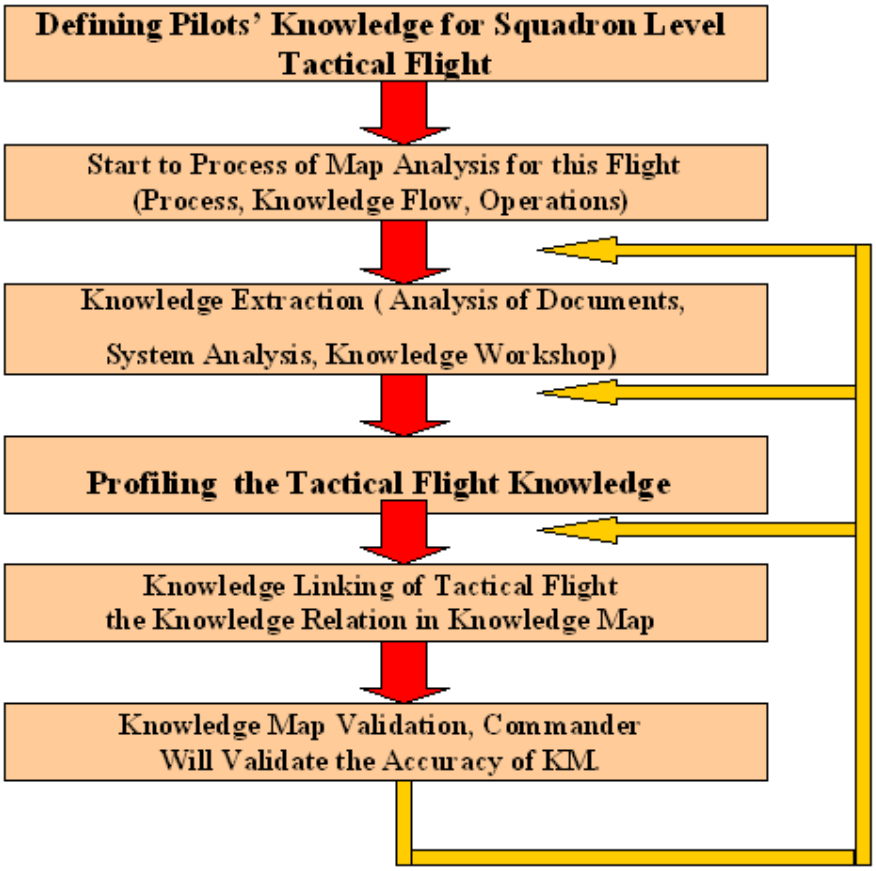

Figure 3.2 : Knowledge Mapping Steps [20]

Defining the Organisational Knowledge :

This step starts with the identification of knowledge, Ontology.

The primary aim of ontology is the identification of vocabulary for defining the knowledge. A secondary aim of Ontology is to provide a common language that can be understood by everyone. This common language helps employees for understanding and using the knowledge. Next step is used to decide for identification of field and detail of mapping by questionnaires and interviews. In field identification it should be decided that if the knowledge map is going to cover the organisation entirely or partially. After identification of the knowledge map field the detailing level should then be identified.

It is important to decide the level of detailing for answering the organisation's requirements. If a lot of knowledge is going to be analysed then the mapping will be very difficult. When the knowledge source of organisation is being analysed operator manuals, outside knowledge sources, meeting reports and projects are used.

Process Map Analysis:

The start point is organisational knowledge work processes. The technical knowledge and exprience during the work process takes place. The knowledge in work processes identification and management help in solving problems. Work processes are being analysed by using process map tecnique. Process map has process, flow, operations and outer objects. The relations during operations are shown by arrows.

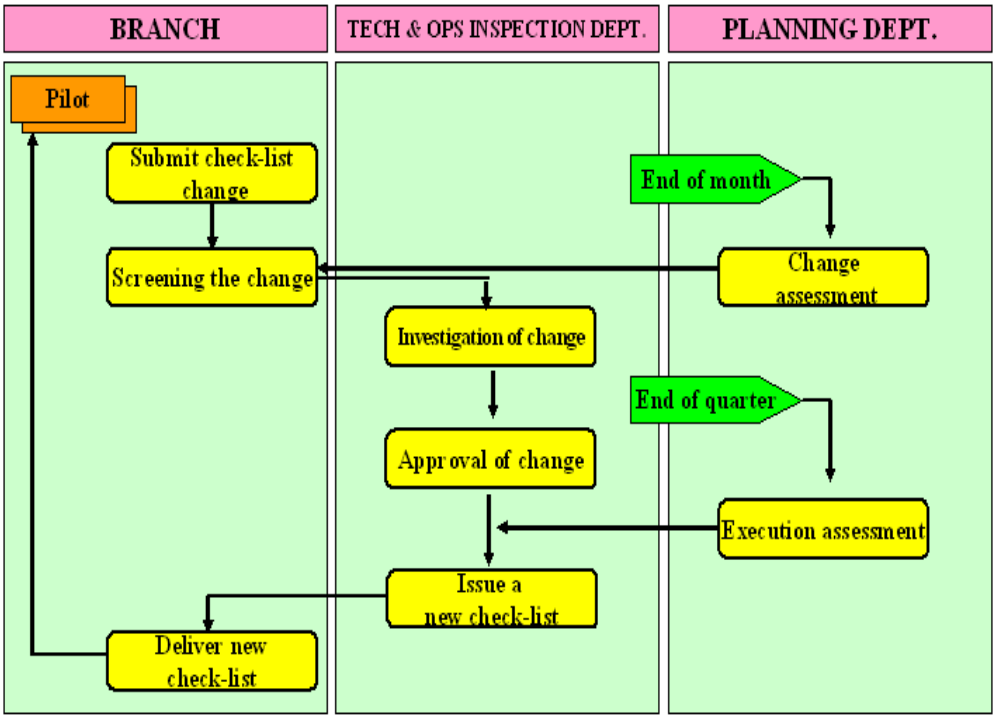

Figure 3.3 : Process Map Analyzing [20]

Extraction of the Knowledge:

In this step knowledge is being extracted by using process maps. The knowledge to be extracted is in three categories. The knowledge required before the work process begins, pinpoints knowledge used during the process and finally maps the knowledge created upon culmination of the process. There can be some knowledge that is not related to the process. [20]

Tecniques for extracting the knowledge are as follows :

- **Interview :** Extracting the specialists' knowledge by using questionnaires.
- **Analysis of Documents :** Operator manuals, organisation schemes, and the knowledge will be extracted from outside sources.
- **System Analysis :** The knowledge within the databases of organisations is being extracted.
- **Knowledge Workshop :** The knowledge will be extracted related to a knowledge field.

Profiling the Knowledge :

The knowledge extracted is being profiled. The quality and the relation with processes of knowledge is being defined. There are two properties of knowledge management:

- To link the knowledge with human being
- To link the human being with another.

Knowledge profiling supports the knowledge process by defining it.

The properties of knowledge profile are as follows.

Number of knowledge, title, type (explicit, tacit), creating time, changing time, format, location, writer, unit, acess permission, key words, definition, importance, specialist.

Linking the Knowledge :

After profiling the knowledge the linkage is identified. The first linkage of knowledge is done during profiling. After these linkages are validated. New links are identified and validation is done. The knowledge relation in knowledge map is shown by arrows. Knowledge map shows the way of knowledge. Knowledge map contains points and links. Each point shows the knowledge and the relation with the previous and next one [20].

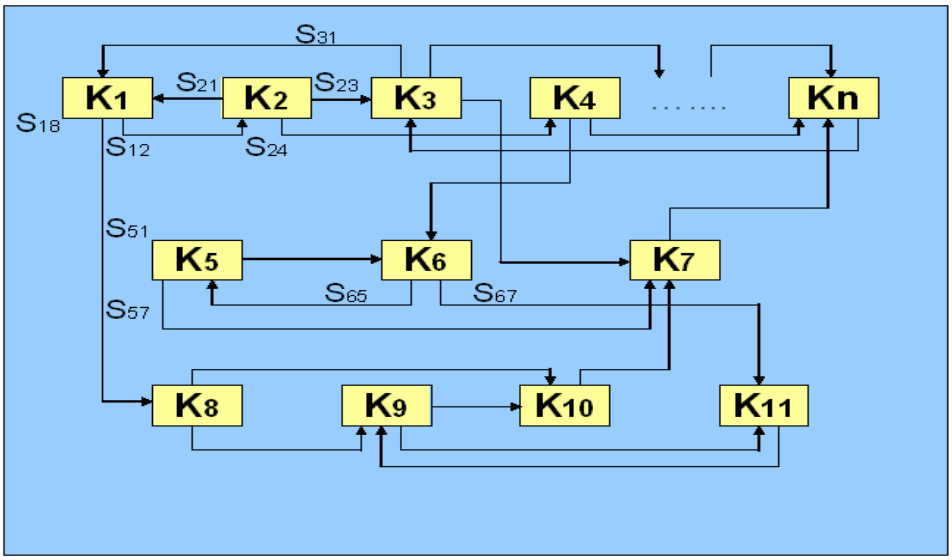

Figure 3.4 : Knowledge Linking [20]

Validation of Knowledge Map:

Specialists, managers and the creators of knowledge maps validate the accuracy of knowledge map by observing.

- Has all knowledge been extracted ?
- Is there more knowledge than required in the organisation?
- Have links and profiles been shown for all knowledge?
- Does knowledge map and knowledge profile fit to eachother?

The products after knowledge mapping procedure completed are as follows.

- **Outputs of Knowledge Maps :** standart terminology, new knowledge creation, knowledge gaps.
- **Knowledge Diffusion Outputs :** final reports, electronic system including knowledge.
- **Human Centralized Outputs :** nets of specialists.

Example: Some aircrafts had engine problems two years ago. This was first discovered by the pilots during some flights. They reported the problem to the technical crew. After a series of inspections it was found that the turbine wings of engines in six aircrafts were damaged.

For the further inspections aircrafts had been grounded to a time that completely had been examined and the problem had been solved. The technical crew could not manage to solve the problem. Therefore they contacted with manufacturer Bell Company. The Company send to the unit a group of engine specialists. After 2 days trial the problem had been identified, the engine turbine wings had deformed because of continuing heavy work conditions. The necessary maintenance and inspection had been done. Eventually the decision of changing the engines of aircrafts were given for four of the aircraft. Upon completion of technical work a new control method were recommended by the company engine specialists. Eventually new controls were started to be done in different periods by unit's technicians.

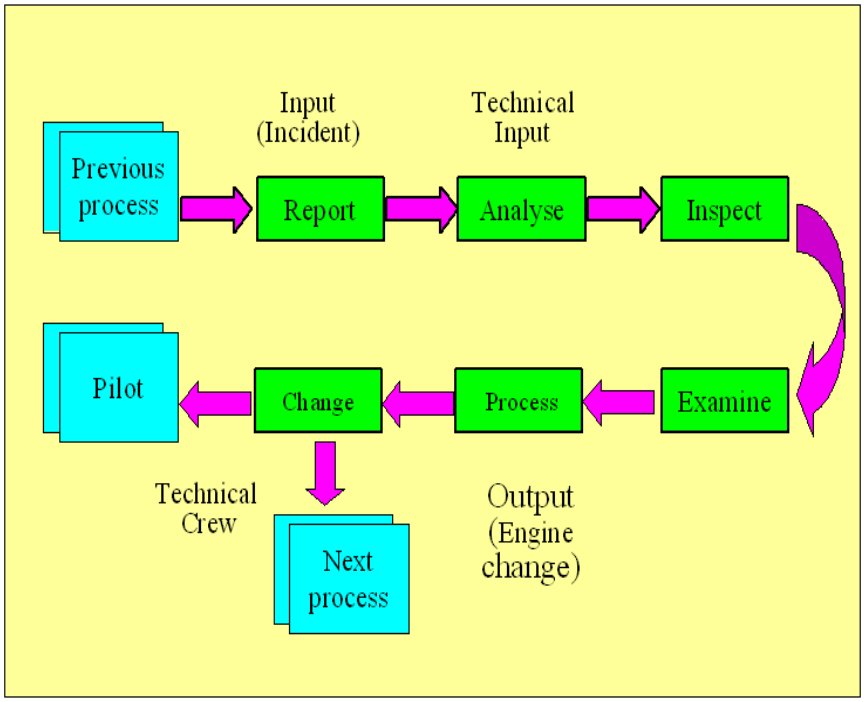

Figure 3.5 : Process Map for Technical Arrangements [20]

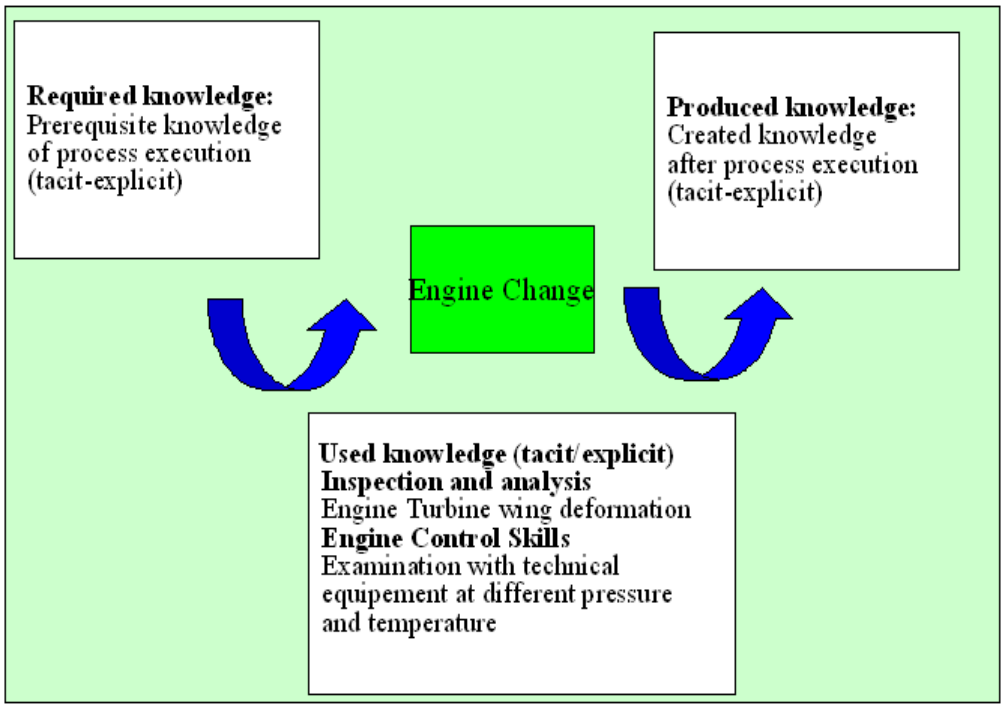

Figure 3.6 : Extracting the Knowledge [20]

Table 3.2 : Knowledge Profiling [20]

Knowledge ID	A-2	**Title**	Eng.Turbine Wing Deformation
Author	M. Smith	**Organization**	Engine R&D Team
Creating Date	10/21/2006	**Last modified**	12/20/2006
Keyword	Engine, Wing	**Expired date**	09/10/2008
Importance	9	**Rating**	6
Type	Tacit knowledge	**Access right**	Limited
Format	Document	**Location**	Turbine Wing
Prerequisite	AA-BB-001	**Expert**	V. Febney
Description	Engine turbine wings had deformed because of heavy work conditions. Immediately all aircraft will be inspected in 5 work days.		

4. KNOWLEDGE MAPPING SOFTWARE APPLICATIONS AND APPROPIRATE SOFTWARE APPLICATION FOR PILOTS` KNOWLEDGE MAPPING

4.1. Discussion on Knowledge Mapping Software Applications

Knowledge mapping has been widely adopted in fields such as education, sociology, informatics, engineering and business. Modern proponents have given knowledge mapping techniques structure, rules and promoted their application in a very wide range of situations. Cognitive map, concept map, mind map, semantic map, semantic network, cognitive structure, knowledge structure, conceptual knowledge are a variety of terms of knowledge mapping. Some of these terms may be synonyms, and comments are restricted to the two popular terms under the knowledge map umbrella: the concept map and the mind map.

There are disagreements regarding the relationship of these two terms to each other. There are different references describing the two, one reference is that a mind map is simply a free-form variant of a semantic network or the name for a unique form of concept map. Other references were equally insistent that there is no similarity between the two: the concept map is supported by scientific study; mind maps are the product of unproven, parapsychological or pseudo-scientific thinking [21].

As a consequence of this debate, there continues to be two schools of thought: those promoting concept maps and those promoting mind maps, as if they are two, complete, separate entities or techniques. Seldom does one read the opinion that “a mind map is a concept map” but, nevertheless, it is believed that this is the case. There is a claim, by some proponents, that concept maps and mind maps can not be converted to each other; however, it is suggested by some that this is not wholly correct and that it requires a significant amount of effort to achieve an adequate result, if either map is of even a moderate size. These maps are really intended to serve very different purposes.

There is a lot of confusion in the world of concept mapping regarding these two terms. A research of numerous sources reveals a rather careless mix-and-match nomenclature to constructed maps by their creators.

The arguments and discussions on the differences between knowledge maps can be disregarded, as it serves no real purpose for their application. Both mapping techniques actually work, but not necessarily both types for all purposes.

The concept map model was developed to satisfy specific requirements in the educational field for teaching and learning and associated evaluation and assessment processes. Similarly, another concept map model was recently developed to satisfy specific requirements in the field of sociology. There are many types of concept maps and techniques for constructing concept maps.

Choosing one map method over another is a personal decision, based on what is the best way to portray the concept for a specific purpose.

It takes time to create a concept map or a mind map, and even more time to revise and refine it. Maps are never really finished and there is always room for improvement, sometimes the maps must be completely re-done.

When a knowledge map has been completed there is often a need for adjustments, corrections and additions which can quickly make a mess of a map, unless it is completely re-drawn. Computer software provides a solution to this problem and maps can be easily revised, re-drawn and completely re-designed. It is convenient to consider the two mapping techniques as uniquely separate because, for the majority of the software industry, that is how the software is designed [21].

When selecting software tools for knowledge maps it is important to analyze whether there are certain types of mapping among the elements in an interface model. There are some computational problems with each knowledge map interface model. Fortunately, the intrinsic nature of each interface model component determines to a large extent the kind of mappings that are possible to and from that component [21].

There are a lot of similar knowledge map software packages on the market, so that the selection process could be narrowed down considerably. Therefore a set of evaluation criteria has been established and they have been assessed to understand how each software package performs assigned tasks. Variety of options is extensive and leads to a wide range of capabilities with this software. Some software is designed for basic personal use whilst others are designed with business in mind. Some offer extensive export capabilities to word processors, spreadsheets, and presentation packages; others have built-in presentation capabilities and can stand alone. Others offer a collaboration option.

Concept Mapping Selection Criteria :
When it was set out to obtain mapping software, first objectives were set down, consisting of some very general characteristics of software that needed to be considered, some personal applications for which the software could be used, and finally some potential business applications for which the software might be used. Then a series of questions to be answered in regard to what others, was set down. Finally, software available was reviewed, tested and attempted to gather the responses to the objectives, expectations, and performance questions together [21].

4.1.1. Objectives

Does the software have following specifications and abilities?

- To re-draw diagrams with ease
- To re-structure or re-arrange diagrams as needed
- To re-map, re-create map designs
- To eliminate the constraint and confinement of “one-pagers”
- To provide an archive of information that would be easily retrievable
- To allow the addition of new information at a later date
- To design, display and print professional-looking maps
- To produce maps that could be easily interpreted, perhaps years later
- To export map information in a convenient form to word processing software
- Ideally, to create both concept and mind maps of equal quality

These were very basic needs but the functionality of available software in this regard varied considerably [21].

Does the software accomplish the following tasks for individual or personal applications?

- Preparing to-do lists
- Researching and learning new concepts and subjects
- Preparing writing reports, essays, papers, etc.
- Assisting in learning a new language
- Note-making, maybe note-taking in real time
- Brainstorming-personal and collaborative
- Preparing and delivery of presentation material

Does the software accomplish the following tasks from a business perspective?

- Planning activities and processes
- Developing, preparing and managing project plans
- Managing meetings, actions, to-do lists
- SWOT analysis
- Change management
- Problem solving
- Resource management & assessment
- Project planning & time management
- Cause & effect analysis
- Impact analysis

The task of evaluating and comparing software to satisfy the criteria above is a large undertaking. The list of questions to be answered were attempted to be made as specific as possible. The end result was a series of questions, under specific characteristic headings, to be considered for each software product [22].

4.1.2. Features

a. System Requirements

- Is the software Windows XP compatible?
- What are the minimum computer system specifications?
- What are the licensing options?

b. Flexibility

- Is there a brainstorming function?
- Can you add notes to concepts?
- Can resources and tasks be allocated?
- Can local layouts be applied?
- What methods are used to enter new ideas? How easy is it?
- How can you change the order or location of concepts?
- How can you change the hierarchical level of a concept?
- What map layouts are available?
- Can layouts be altered?
- Can the map be edited from within an outline view?
- Can the map branches be numbered?
- Can the outline be numbered?
- Can the maps be fitted to one and multiple maps?
- Scalability—can one zoom work to get more detail?
- How flexible and varied are the principles and elements of design (line, color, shape, value, texture, space, form, balance, emphasis, unity, variety, proportion, movement, etc.) for branches, nodes, twigs, etc.?
- Can maps be automatically transformed to other map representations or formats?
- Is there automatic language translation?
- Is a collaborative option available? Networkability?

c. Display

- How are notes indicated?
- Is the notes field visible while editing the map?
- Can notes be viewed in the outline view?
- Is a text outline view available?
- Can the outline and map be viewed at the same time?
- Can overviews be generated?
- Can display focus be set at all levels?
- Is graphical differentiation between concepts and links, areas, zones, clusters, etc. available?
- Can elements in the map be proportionately sized according to parameters or properties of the concepts and linkages being represented?
- What filter options are available?
- Is there a presentation view function to avoid having to export to MS PowerPoint? [21]

d. Editing

- Can notes be formatted?
- Can notes be spell-checked?
- Can map text be formatted?
- Can the map be spell-checked?

e. Import/Export Options

- What various file formats can be imported & exported?
- Can information be imported and converted from various formats?
- Can notes be exported?
- Can text outline be exported to MS Word?
- Can the map be exported as a presentation?
- Can maps be exported to those who don't have the program?

f. Map Enhancements

- Can concepts consist of virtually unlimited textual content?
- Can you attach an image to a concept?

- Can images be added to the map without text?
- Can icons be used to categorize concepts?
- Can multiple files & hyperlinks be attached to concepts?
- Can you link another map to a concept?
- Can boundaries be set and how many? Can they be nested?
- Can concepts be categorized?
- Are Mental Connections possible?
- Can personal categories, symbols, and icons be added to the program for use as such? Maybe they can be added, but they are still treated as just additional images.
- Can un-associated floating images and text be added?

g. Templates

- Are there various draft templates available?
- Can user templates be designed?
- Can personal templates be set to default?

h. Print Options

- Can maps be printed in various configurations and formats?
- Can the outline view be printed?
- Can headers, footers, drafting identification blocks, titles, etc be added during the print phase?
- Are notes printed with the map or separately? [21]

i. Manipulation

- How easy is it to get around the software (keyboard controls, mouse control, menus & icons?
- Is there a Navigator bar?
- Are maps configurable or set to specific designs (such as radial, affinity, funnel, input, output, organogram, and outline for mind maps)?
- Can branches be moved, yet still tied to the parent branch?
- Can branches be freed and moved about (but still bound to parent branch)?
- Can branches be re-arranged at all levels?

- When brainstorming, how easy is it to add multiple entry nodes without using a lot of keyboarding or mouse movements (should be able to enter multiple text blocks, each followed by a Return)?
- Can I manipulate the overall design on the fly in order to adjust as the map becomes more complex (refresh, re-arrange branches, select new configuration)?
- Can pages be set at will (important for large maps, is option even available; if not, what's the alternative)? [21]

j. Screen Views

- Are the menus easy to read and are they configurable?
- How flexible are the windows (re-sizeable, hide)?
- How varied and flexible are the Views and Map Arrangements that are possible?
- Can the screen be cleared of everything but the map or the outline (some auxiliary windows may not be completely hidden, therefore taking up valuable work area)?
- Can I set the focus on a particular node?
- Are Page Breaks available?

k. Design Options

- Can images, text, icons be attached to a node but not necessarily be imbedded in the node itself?
- How easy is it to design nodes, branches and twigs?

l. Price

Is the price of software application expensive?

When it was laid out; however, the degree to which they meet the criteria satisfied varies considerably. If software is only wanted to do simple mind mapping, then any of these packages would suit . The software that was looked at was that which would meet the criteria to the greatest degree possible.

Each criterion was ranked per program on a scale of 0 to 5, zero meaning the option or feature wasn't available and 5 meaning the software offered exactly what was looked for.
The ranking was subjective and qualitative. Despite the selection available, however, a single software package that fully met all the demands was not found; so it had to be compromised. When it came to trial testing software, several packages were selected as satisfactory.

Freemind was the first mind mapping software that was found, so all other freeware was compared to it. There were not significant differences and certainly not enough to warrant changing the selection. As for Mind Mapper, it was the first trial software that was downloaded. Whenever, a new software was looked, it was compared to Mind Mapper and often were found too many similarities to warrant changing the selection.
Eventually six other, more expensive, packages were added: Sim Tech System Mind Mapper, ConceptDraw MindMap Pro, MindManager Pro, MindGenius Business,Smart Draw mind map and Visual Mind 8. Freemind really did meet most of the needs. If the software has only to provide brainstorming, planning and to-do lists, then this software is more than adequate and, it's free.

Initially Mind Mapper was deemed that it would be better, but it too lost some ground to the remaining five packages, once a detailed comparison was done. Mind Mapper had some features that but was not adequate. The comparisons are usually again based on feature availability, rather than performance.

Feature comparisons are necessary, but it was needed to be found out how the software would perform in completing a typical map that might be created. This would not only give an idea of how well each program could produce an expected map, but would also give an idea of how the program performed in actually producing the map [21].
A mind map was constructed, using the seven selected software packages. The objective was to produce the same map, as much as practically possible, using the basic formatting features of the software and not resorting to any convoluted manipulations.

It was wanted to be able to intuitively construct the maps, with minimal manual referencing. The seven figures that follow depict the maps that were generated with each program.

All the maps have the same basic format and the same structure. Differences lay in the additional features possible with some software, the look of the display, the feel of working with the software, the print and output capabilities, and the ease of map creation and manipulation [21].

Finally software applications were evaluated according to the criteria as in the table 4.1. The scores are very near to each other. Freemind was selected in the first two. The software can be downloaded without any charge. This will be a good start to use a software application as a beginning in the organisation. When the requirements will not be answered by this application more research can be carried out for better software applications.

Table 4.1 : Comparison for Software Applications

	Criteria Weight	**Free Mind**	**Mind Mapper**	**Concept Draw MindMap**	**Mind Manager**	**Mind Genius**	**Smart Draw**	**Visual Mind**
System Requirements	0.10	2	2	2	3	3	2	2
Flexibility	0.10	3	3	3	2	3	2	2
Display	0.03	2	2	2	3	3	3	3
Editing	0.02	4	4	2	3	3	3	2
Import/Export	0.12	2	2	2	3	3	3	3
Map Enhancements	0.13	2	2	3	2	3	3	3
Templates	0.08	2	3	2	3	3	2	3
Print Options	0.06	2	2	2	2	3	2	3
Manipulation	0.06	2	2	3	3	3	2	3
Screen Views	0.01	2	3	3	3	3	3	3
Design Options	0.14	2	2	3	3	3	2	3
Price	0,15	5	2	1	0	1	2	1
Total	1.00	2.59	2,23	2,29	2,26	2,70	2,31	2,48

4.2. Freemind

FreeMind is a premier free mind-mapping software written in Java and it is accessable free from any charge. The recent development has turned it into high productivity tool. The operation and navigation of FreeMind is faster than that of MindManager because of one-click "fold / unfold" and "follow link" operations. If you want to keep personal knowledge base, you can prioritize and know where you are, where you've been and where you are heading, FreeMind helps to keep track of all the things that you want to put in the map. [23]

Maximum and Minimum Versions:

FreeMind is available in two versions: maximum and minimum. Minimum version is considerably smaller to download, having around 3 MB instead of 8 MB. Maximum version contains additional plug-ins, downloadable also from files section [20]. The plug-ins feature exporting to Scalable Vector Graphics (SVG), exporting to Portable Document Format, reminders that can be attached to nodes, and help for FreeMind reminiscent of help usually delivered with Microsoft Windows applications. To run FreeMind, do one of the following. [23].

- In Windows, double click Freemind.exe, or on any operating system, double click freemind.jar in the lib/ folder of the folder in which FreeMind has been installed.
- System requirements: Java Runtime Environment or Java Runtime Environment for Mac OS X, Microsoft Windows Installer Max, Mac OS X, Linux or Any operating system

Current Users of FreeMind Use it for the Following Purposes:

- Keeping track of projects, including subtasks, state of subtasks and time recording.
- Project workplace, including links to necessary files, executables, source of information and of course information.
- Workplace for internet research using Google and other sources.

- Keeping a collection of small or middle sized notes with links on some area which expands as needed. Such a collection of notes is sometimes called knowledge base.
- Essay writing and brainstorming, using colors to show which essays are open, completed, not yet started etc, using size of nodes to indicate size of essays.
- Keeping a small database of something with structure that is either very dynamic or not known in advance. The main disadvantage of such approach when compared to traditional database applications are poor query possibilities, You learn about the structure from the additional data items you enter. For example, different medical records use different structure and you do not have to analyze all the possible structures before you enter the first medical record.
- Commented internet favorites or bookmarks, with colors and fonts having the meaning you want.

Features:

Apart from other things, this release of FreeMind features:

- Fully functional following of HTML links stored in the nodes, be it www links or links to local files.
- From very early versions, Freemind supports folding which is its essential property.
- Fast one-click navigation, including folding / unfolding on one click and following links on one click at the same time (you don't have to make choice between fast following of links and fast fold/unfold). You can move the map by dragging the map's background as well as using mouse wheel.
- Undo
- Smart drag'n drop, including the possibility to copy nodes or copy style of nodes; dragging and dropping of multiple selected nodes; dropping of texts or list of files from outside.
- Smart copying and pasting into, including pasting of links from HTML or structuring the pasted content on the basis of the number of leading spaces in a line; pasting of lists of selected files.

- Smart copying and pasting from, including plain text and RTF (MS Wordpad, MS Word, MS Outlook messages).
- Export of map to HTML, with folding.
- Find facility, where found items are shown one by one as you do "find next", and the map is unfolded only for the current item.
- Possibility to use and edit long multiline nodes; even with newlines.
- Possibility to decorate nodes with built-in icons, colors and different fonts.
- Low costs of risk of switching away to another mind mapping tool, because FreeMind stores maps in XML format. If you have a lot of maps created by FreeMind and you want to switch to another program, writing a conversion program should be easy, especially if that program features Visual Basic scripting facility. File mode enables you to browse the files on your computer, seeing the folder structure as mind map.

Weak Spots Include:

- The support of pictures in nodes is in preliminary stage. When you want to carry a map around with you, you have to take care that you take the image files with you.
- FreeMind is basically one user application. Although users can in principle work on the same map, there is only preliminary locking mechanism to prevent conflicts, at the time, switched off by default.
- In rare cases, following of HTML links in the web browser does not work on some computers; the same holds for opening local files.
- Limited support for fancy graphics.

Licence:

FreeMind is a free software, licenced under GPL - GNU General Public License [23] . Basically, that means that you are free to use FreeMind to whatever you want without paying for that, and that any code derived from current FreeMind's code must also be licenced under GPL. FreeMind is also open source software [23] .

Documentation:

FreeMind comes with the documentation in the form of mind map, available from application menu *Help* > *Documentation*. The documentation is a succint description of FreeMind functions, rather than a mind mapping text book. You can also browse the documentation in a Java applet browser (with around 700 KB that requires Java 1.4.2 or later) which gives you a proper FreeMind feeling. And you can try a much smaller flash based FreeMind map viewer. A similar documentation is also available in the form similar to Windows help, in application menu *Help.*

Freemind ranked second on the list with a score of 2,59. If it was basic maps that were of interest, then this program would have provided what can be wanted at no cost. No scaling or local layout control were available, so one can't tinker with the map layout. There is no image capability; according to the literature, this is a noted weakness of the program.

Figure 4.1 : A Knowledge Map Model which was Created for Pilots with the Free Mind Software

4.3. Mind Mapper

SimTech Systems' Mind Mapper 4.5 Pro came in seventh at a score of 2,23. The program auto-adjusted as branches, twigs, images, re-formats were added, always maintaining a clean display. Re-scaling was very easy. Local branch-twig layouts were possible, without using the 'focus' feature, something that only Mind Manager and MindGenius, could also do. It were produced large maps, however, and as with Freemind, the ability to produce sub-maps did not appear to be possible with the software. It costs USD 180.00. [24]

Features:

Easy-to-use intuitive, Windows Users interface software: no need for extensive training, start mapping right away to, develop and organize thoughts as a brainstorming session.

Tool bars and menus: provides direct and immediate access to commonly used items.

Spell check: quick and intuitive automated spell check feature.

Tasks: graphically view tasks in chart form, easy input of task start and end date.

Hyperlink to website or files: hot link to any website, e-mail, map or file.

Hyperlink to multimedia files: hot link to any multimedia files such as audio or video clips.

Repair hyperlinks: automatically detect any broken hyper links for easy updates.

Built-in scheduling (Gantt chart): a visual chart view of all topics/tasks for scheduling with built in chart.

In-depth scheduling features: select numbers between week, month and year.

Build-in resource allocation: resources can be allocated to taskes with/without schedules.

Easy division of topics: topics can be divided into separate maps with a click of a button.

Bitmap export: export maps in bitmap format for easy pasting into other programs.

Pack and go: compress all linked files in a zip file for restoring of a map file into other location.

Scheduling by defining and assigning resources: projects, factor time and budget planning possibility.Auto paste: instantly capture ideas from the web or other digital files by scanning words.

Integration Microsoft Office Products: export to Microsoft® Word, PPT, MS Excel file, brainstorm schedule, assign tasks and resources, set start and end times, then export to Microsoft® Schedule, Integrate with Microsoft® Outlook tasks. Publishing: convert map content into web pages, print documents to specified number of pages to overlap tiles. Or, print documents to specified topics; print individual maps or multiple maps, print charts with start and end date of tasks for easy overview, save MindMapper files as a graphic image with hyperlinks, the printing scale of a map can be adjusted. [24]

Design elements: create maps in different directions, branch out your maps in different angles for various visual options, show a clear direction by using lines with arrows, finally it supports Theme Windows Native XP, Office XP, MS Office 2003. [42]

System requirements: Pentium processor, Windows 98/Me/2000/XP

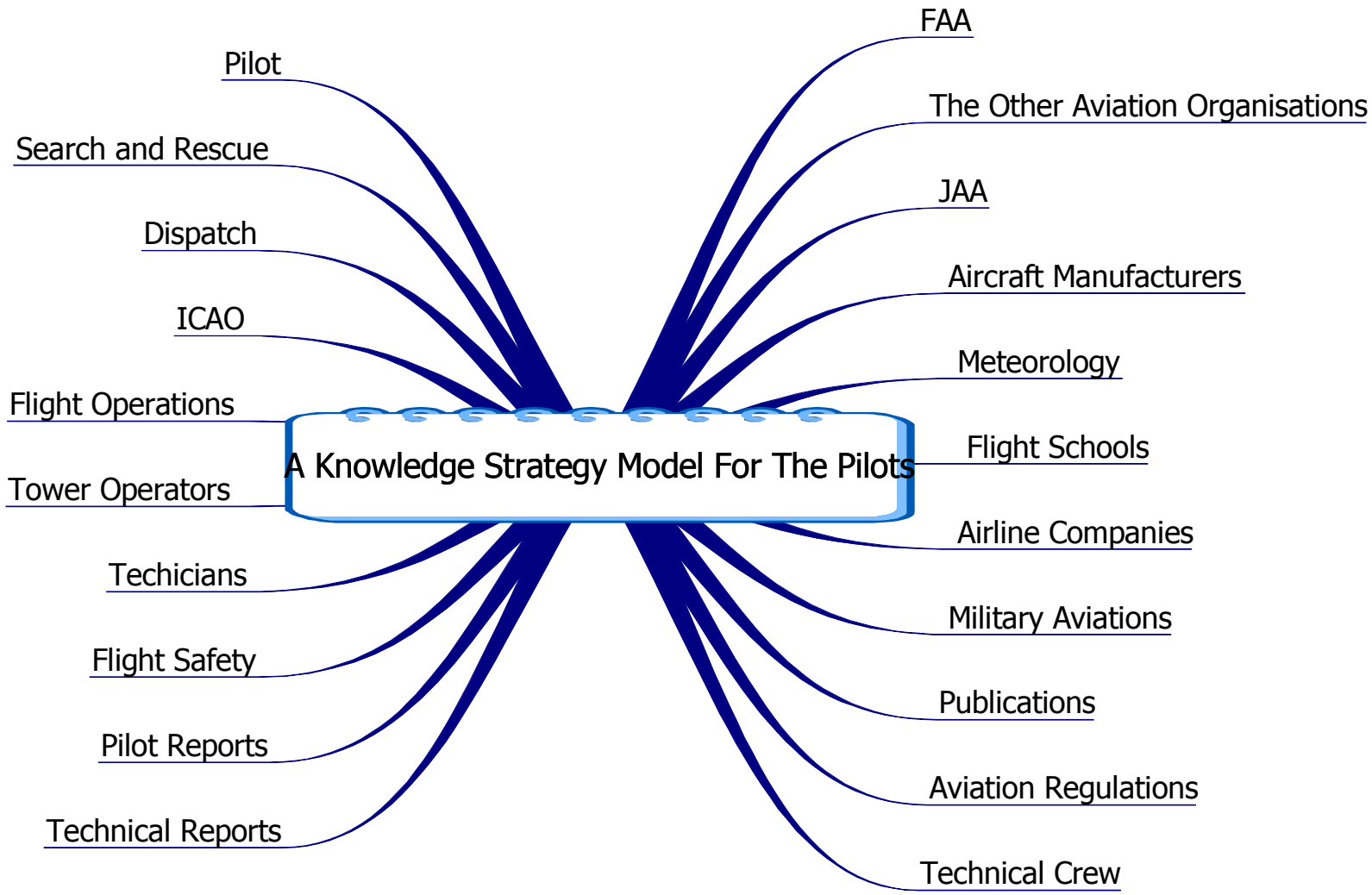

Figure 4.2 : A Knowledge Map Strategy Model Created with the Mind Maper v 5.0 Software Application.

4.4. ConceptDraw MindMap

CS Odessa's ConceptDraw MindMap 4 Pro came in fifth at a score of 2,29. At first, working with this program, it was found to be the most flexible of all the programs in terms of layout control. It was the one program that allowed independent movement of all branches and levels. However, the control option in the program could not be found, to force auto-adjust as branch information was added, resulting in branch and text overlaps until the map was refreshed. Local layout control was also lacking. Maybe this can be adjusted through options, but the solution was not found. Graphics control, however, was excellent. [25]
One feature that was impressive about this program was its ability to isolate separate branches or even whole maps, yet keep them within the same instance of the program. For large maps, this becomes very useful because the map can be broken down into independent sub-maps, but maintained within the same file, and one mouse-click takes you to any sub-map. [26]

One drawback, however, was that only one attachment could be applied to each branch. This presented a problem trying to attach several web links and some files to a branch. The result of this was creating multiple dummy branches, each containing one link, where one should have sufficed.

For branch variety, this program offered the most options for layout, colour and independent control. Consequently, it offers the greatest variety of map variations, far more than any other program reviewed. [27]

On top of these features, this program was the only one reviewed that has a built in drawing program and an extensive option file of template adjustable symbols. Using this option, it’s possible to construct a concept map without actually using the mind mapping control within the program. But it also means that any mind map can be embellished internally much more so than maps generated by other programs. It costs USD 310.00.

Features:

It is a mind mapping and brainstorming tool. The Mind Map View is synchronized with outline allowing to switch between graphic and text views and work with the map and outline simultaneously.

Add new topics: over the place where you would like it to appear.

Add topics in free hand mode: by dragging them out of the selected topic, choose MINDMAP or MindManager symbol sets, in particular, when working with maps created in MindManager. On the whole, the MINDMAP set of symbols exceeds 3000 icons.

Use text notes to supply additional information where necessary. You can edit them in the floating window. When exported to HTML, notes come up as hints in the browser. [24]

Arrange or sort tools you can rearrange topics, lay out them in different directions, sort by priorities or alphabetically.

Select among multiple pre-set map styles: change the style of the entire map.

Multi-page documents: it allows creating highly detailed, multi-level maps. You can produce a complete multi-page website by exporting such a map to HTML and easily navigate through its pages in the browser.

You can add your comments to the topics using Callouts. The floating topics allow placing random ideas that do not concern the map subject matter outside your map and then go back to these ideas later.

Besides mind-mapping tools, ConceptDraw MINDMAP features powerful flowcharting tools: vector drawing tools, automatic shape connectors and more for creating pro-quality flowcharts and diagrams.

MS Office compatible: the advanced export to MS PowerPoint allows opening and animating maps created ConceptDraw MINDMAP in the popular presentation software.

Project planning features: the task information dialog allows adding start and due dates, duration, percentage completed and resources to the topics. This feature enables project managers to generate and analyze task lists of their projects in MINDMAP and then export the lists to project management applications such as MS Project XML, ConceptDraw Project and Leading Project file formats. [24]

Import/export capabilities: in Professional version you can save your files as PDF (Portable Document Format). This format allows for exchanging and printing documents across different platforms.

System Requirements:

Macintosh Version:

- Mac OS version Mac OS X
- PowerPC G3 processor
- 256 MB of RAM
- 100 MB of free hard drive space
- CD-ROM drive (for installation)

Windows Version:

- Windows 98/2000/ME/XP
- Pentium or higher processor
- 256 MB of RAM
- 100 MB of free hard drive space
- CD-ROM drive (for installation)

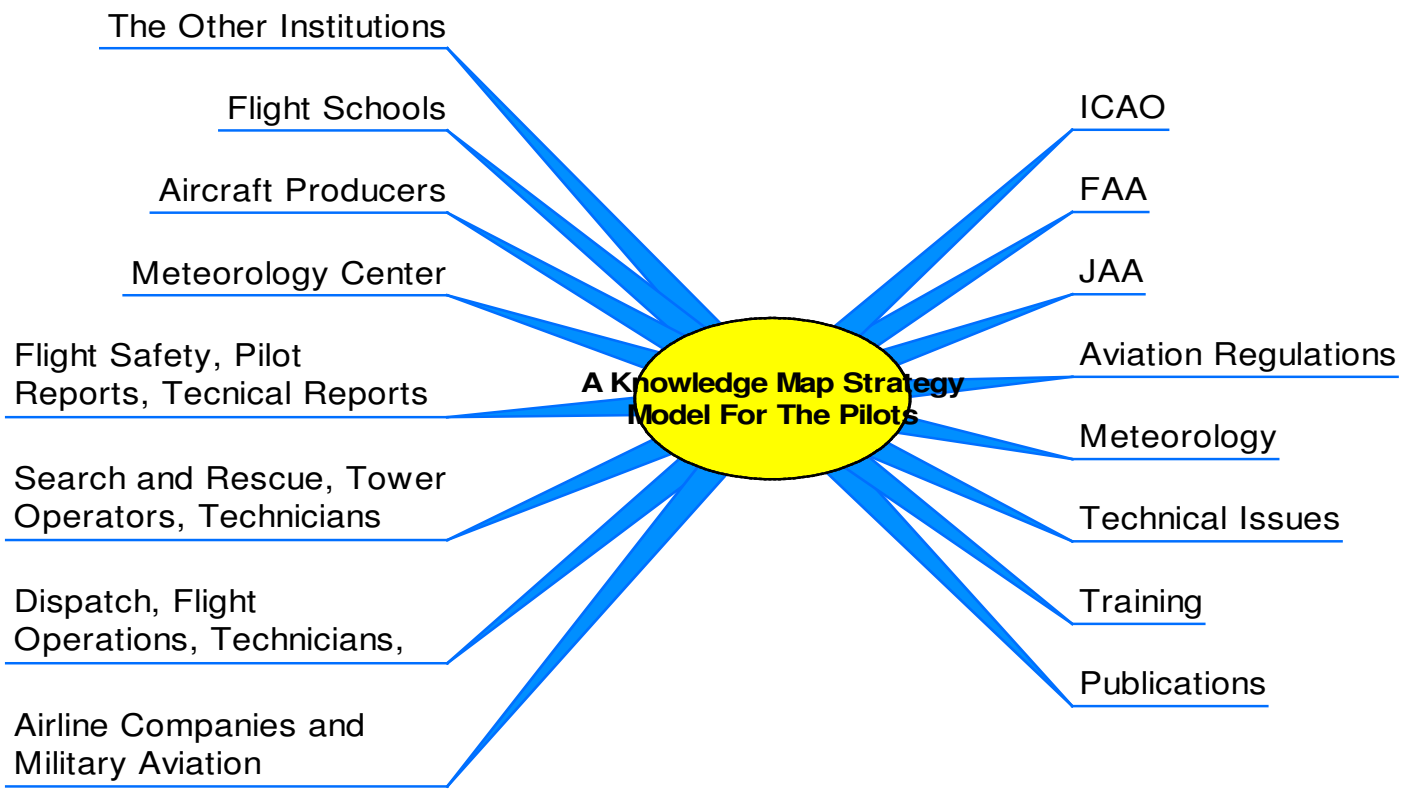

Figure 4.3 : A Knowledge Map Strategy Model for the Pilots Created by the ConceptDraw Mind Map 4 Pro Software Application

4.5. Mind Manager

Mindjet Corporation is a provider of productivity software for visualizing and managing information, allowing individuals and teams to more effectively think, plan, and collaborate. Used by the majority of Global 2000 companies, the Mindjet® MindManager® product line enables users to visually connect and synthesize ideas and information to improve decision making, shorten business planning processes, and harness the intellectual capital in their organizations. With headquarters in California and operations throughout the world, Mindjet is backed by international venture capital firms Investor Growth Capital, Inc. and 3i.

Mind manager is a commercial mind-mapping application, developed by Mindjet. Mindjet describes maps created with MindManager as 'Business maps' for use within enterprise distinguishing them from hand-drawn mind maps. The results from MindManager can be exported to Microsoft Word, Power Point, Visio and Project, as web pages, and as PDF documents. A mind map is created by hitting Insert and Enter to reate new topics and subtopics. MindManajer mind maps can be visually customized extensively, including the addition of symbols and graphics.

About Mapping :

Mindjet's mapping software enables users to create readily understood and highly interactive visual representations of complex ideas, information, and data. This concept represents an evolution from an earlier, pen-and-paper-based data capture technique known as mind mapping. Based on scientific research into the working of the human brain, which began in the 1950s, mind mapping has remained a useful technique for improving individual creativity and memory retention [28].

The key to Mindjet MindManager's utility as a business application is an interface that expands to accommodate new information. The interface captures information by means of a visual hierarchy of cascading topics and subtopics.

Mindjet® MindManager® Pro 6 transforms brainstorming ideas, strategic thinking, and business information into blueprints for action, enabling teams and organizations to work faster, smarter, and with greater coordination.

It extends core mapping functionality with a host of simple tools–collaboration, distribution, administration–making it easy for business professionals to quickly deliver bottom line benefits enterprise–wide. The company has the products MindManager Pro 6, MindManager Basic 6,MindManager 6 Mac, MindManager Viewer. The price for MindManager Pro 6 is Euros 349.00, MindManager Basic 6 is Euros 199.00. It is also possible to reach to MindManager Pro6 free trials via Web Page for 5 or 21 days. [28]

Features:

In order to run this program minimum system requirements are listed as follows.

Microsoft Windows 2000 Professional

Microsoft Windows Server 2003

IBM or Pentium microprocesser Minimum 700 MHZ

256 MB Ram

150 MB Disc Space

SVGA (800 x 600) 256 colours (16 byte coloured 1024 x 768)

MindManager Pro 6 has all the features of the Basic edition plus more. It also supports large scale deployment in enterprise environments. Microsoft® Excel® Linker Display Microsoft Excel spreadsheets and charts in MindManager maps.

Power select/filter: quickly select or filter topics based on a combination of criteria to show only the important information that is needed.

Custom properties: create custom map parts to capture information. Define topic properties to create a reusable information structure.

Microsoft Outlook integration: display and synchronize Microsoft Outlook e-mail, contacts, calendar, tasks, notes and folders in maps.

Topic alerts: topic alerts synchronize with Microsoft Outlook calendar enabling you to stay current on topic due dates.

Microsoft project Integration: import from and export to Microsoft Project for integration with leading project management tools.

Microsoft Visio® export: easily convert maps into process diagrams by exporting to Microsoft Visio.
PDF export: publish maps to PDF format for platform-independent distribution.

Review mode: track, accept, and reject topic changes made by team members or co-workers. [29]
Multimap workspace: view thumbnails of linked maps for quick navigation. Search linked maps for key words and information.
Data interchange: customize maps by integrating enterprise data sets and Web services.
Macro editor: create and edit add-in scripts to develop custom functionality.
Lotus notes hyperlink: hyperlink to Lotus notes documents in mail, calendar, address book and to do list. Supports Lotus notes 6.5 only.

Mindjet's MindManager Pro 6 came in sixth at a score of 2,26. This appears to be a nice, tight program that produces very clean, organized maps. It is found this rigidity to be a drawback of the program; all map examples that have been seen on the internet also tend to look the same. For a program as sophisticated and business-oriented as Mind Manager, better control of map segregation wasn't available. While a 'focus' feature may allow temporary isolation of a map segment, maps are often so large that linkages to a separate map would be preferable, without actually creating separate maps.[28]

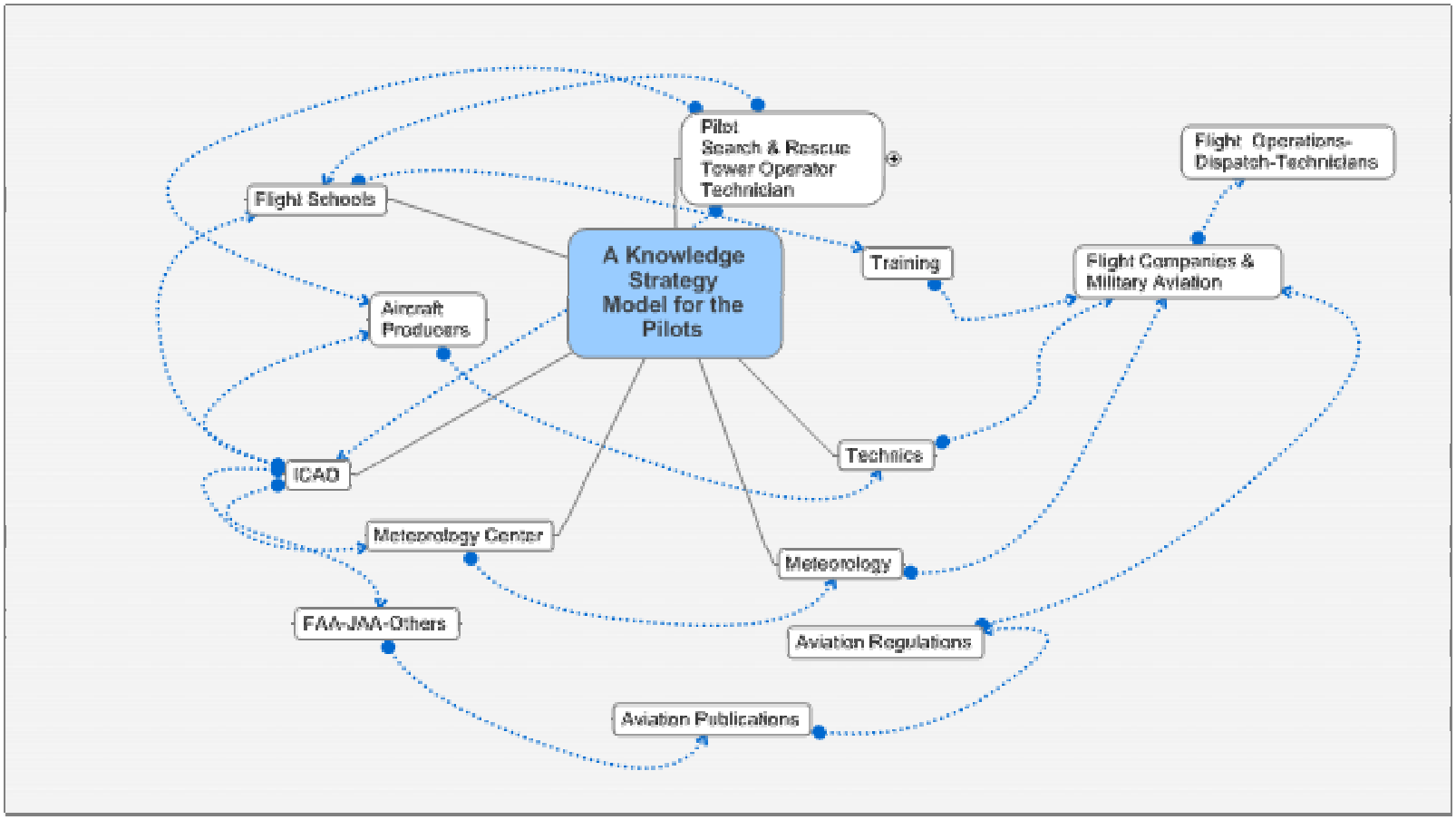

Figure 4.4 : A Knowledge Map Strategy Model for the Pilots Which Has Been Produced with Mindjet Manager Pro 6 Software Application

4.6. MindGenius

Gael's MindGenius Business 2005 came in first at a score of 2,70. MindGenius offered just about everything the other programs offered and more. It constantly auto-adjusted for additions. It allowed local branch layout control. Scaling and tweaking were easy. Image manipulation were easy and images maintained their proportions. The program offered the variety of templates; and plenty of branch layout control was available, although not near to the degree that ConceptDraw MindMap offers. The variety of import/export and I/O options available was probably the greatest with this program. [30]

For large maps, page breaks could be inserted within the map to indicate where a branch segment would be printed on a new page. For very large maps, it was easier to link to another map, which would be brought up in a second instance of the program. The ability of this software to produce several options for presentation material was an added feature that had not been initially considered. Priority setting, category selection, and associated sorting were big features of Mind Manager and MindGenius, as resource allocation was also. All the software in this category came with on-line documentation; however, MindGenius' documentation was the most extensive and provided detailed examples of each major optional use for the software. Single user licence price is USD 247.00.

Features:

Fast information capture: quickly capture, develop and reorganize topics.

Notes: support topics with rich text, images and tables using a re-sizable window.

Notes: choice of window docking positions.

Spell check: reliable spell check and correction ensures quality before presenting or publishing.

Supporting information: in-depth suite of resources includes animated tutorials, sample maps, and tips, in-depth management technique instructional documents and templates.

Print as map or combined with text outline: flexible printing options save time and effort, auto orientation for best results, user defined page break.Hyperlink to web or files: link to any Web site, map or file, including graphics, spreadsheets, docs, PDFs.

Map templates: instructional management technique templates, reusing specific topics, formats, and/or content.
Protect document: controlled access supports team collaboration and security.
International unicode: support for double-byte characters, including Arabic, Asian languages, Hebrew and Slavic.
Filter: view only pertinent information.
Map view: rapid action plans, re-creating map based on allocated resources, rapid grouping following brainstorm, re-creating map based on allocated categories.
Distribution: zip maps with all linked files for quick and easy external distribution.
Task info: efficiently manage workload, as maps, project plans or actions.
Smooth text/graphics: new look and feel, with a Windows XP-based graphics library.
Library: contains professional images, icons, and backgrounds for clear communication.
Multiple select/format: painter select or format multiple topics using a single click and drag action. [30]
Action bar and menu: provides direct access to a variety of views and modes.
Map view: default view shows top-level information in the form of a workmap.
Integration: Microsoft Word, Microsoft PowerPoint, Microsoft Outlook, Microsoft Project, Microsoft Visio, Adobe Acrobat, Pocket MindMap integration.
Publishing: save as web pages, instantly convert map content into professional web pages for publishing, graphics export, PDF export.The MindGenius applications will install on Windows 95, 98 Windows NT, Windows ME, Windows 2000 and Windows XP

Minimum system requirements are:

- Intel Pentium 90 processor
- 32 MB of available RAM
- 20MB of available hard disk space
- Graphics card capable of displaying a resolution of 800 by 600 pixels with 256colours.

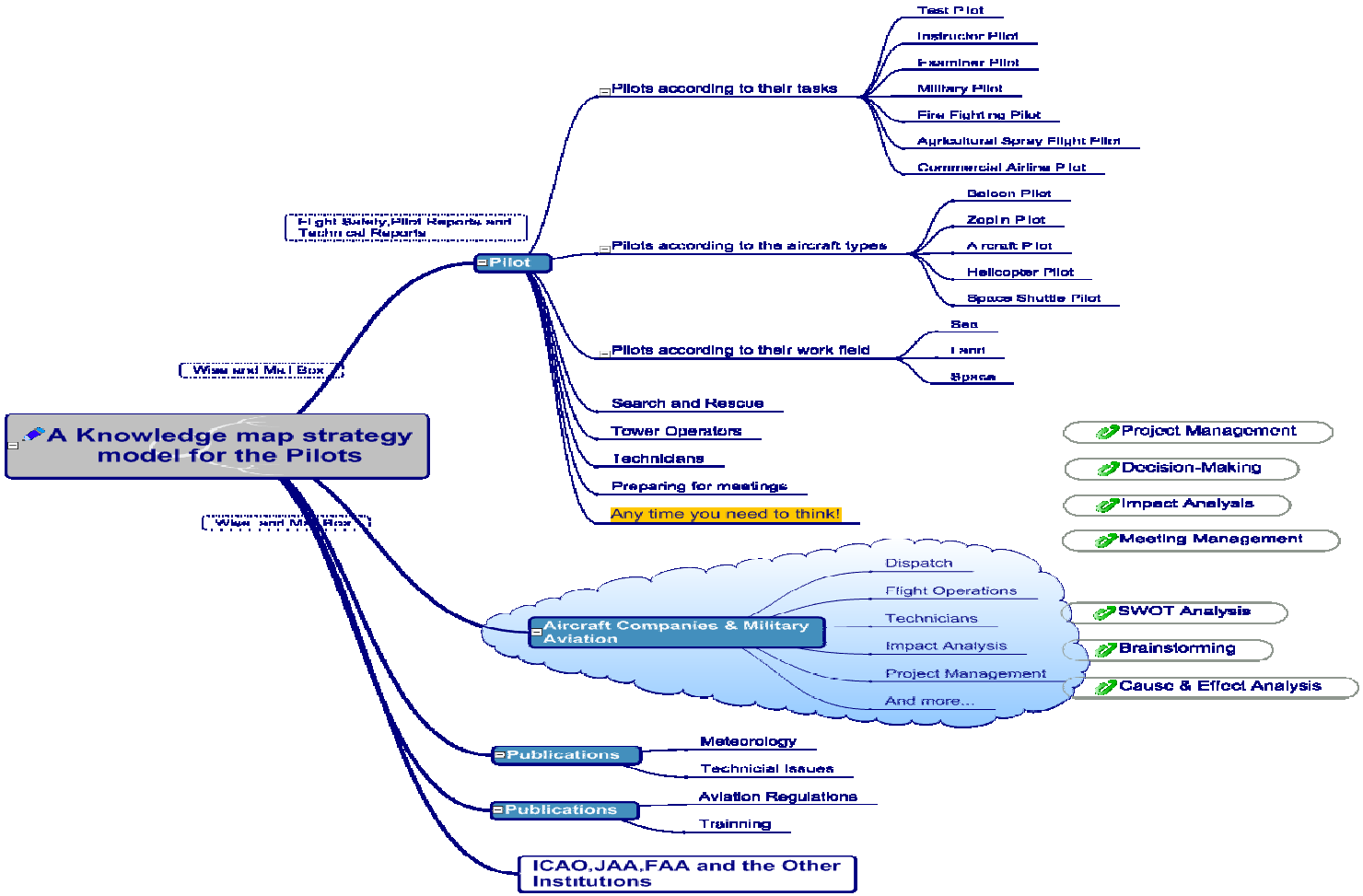

Figure 4.5 : A Knowledge Map Model Created with Mind Map Genius Software

4.7. SmartDraw

Founded in 1994, SmartDraw.com is the creator of SmartDraw, *Business Graphics Software*. SmartDraw makes it easy for anyone to create professional-quality business graphics such as flowcharts, org charts, Gantt charts, timelines, floor plans. SmartDraw has developed many of SmartTemplates for every type of business graphic. Each SmartTemplate loads a diagram specific SmartPanel™ command set and the associated SmartHelp™ step-by-step instructions. By using a SmartTemplate, it is possible to create a complex diagram and graphic design.
The software company use direct-to-user Internet distribution model. The majority of its sales are delivered electronically, directly to the user. For general business users, SmartDraw 2007 is the choice for creating more than 33 types of charts and diagrams, including flowcharts, Gantt charts, timelines, organizational charts, calendars, flyers, floor plans and technical diagrams. The price of this application is 197.00 USD. The free trial is available on their web site for 30 days use. This visualisation program has 17 different groups of engineering and training flow charts, knowledge maps and organisation charts [31]
In addition, SmartDraw 2007 is available in two industry-specific solutions: SmartDraw 2007 Legal Edition and SmartDraw 2007 Healthcare Edition. Each edition includes all the SmartDraw 2007 features and functions plus industry specific SmartTemplates, examples, symbols and SmartHelp. The integration of the software with office programs is very good. [31]

You can import your own custom image as a background. It's easy to transfer drawings into Word, PowerPoint, PDF. Adding a new row or a new column to the form just means a single click. the appropriate template and SmartDraw's SmartPanels™ combined with a context sensitive SmartHelp™ will walk the user through the process of creating.

This application is not a special knowledge mapping application but its features related to flow diagrams and graphic design are very efficient. SmartDraw came in fourth at a score of 2,31.

Features:

Symbols and Shapes:

- Over 20,000 shapes and symbols to click and drop into drawing
- Copy and paste your own symbols, icons, and clip art
- Size and move symbols with the mouse
- Automatically make selected symbols the same height, width, or both
- Automatically align symbols, shapes, and lines
- Automatically space symbols, shapes, and groups of symbols and shapes
- Rotate and flip symbols, lines, and text by any angle
- Combine symbols into groups and then un-group them again
- Connect symbols with lines that stay connected, even when you move or resize them
- Join lines and curves into new fill-able symbols
- Change the color or fill texture of your symbols
- Create your own fill textures from a metafile or bitmap

Drawing Tools:

- Auto Flow automatically inserts connecting lines between shapes. Just drag a symbol next to another symbol and a segmented line automatically and perfectly connects the two shapes
- Area Calculation lets you see the exact area of a shape as you draw it, with the measurements scaling up and down as you change the shape's size in any way. The dimensions can be viewed all the time or only when a shape is selected
- Automatic Dimensioning lets you view the length of any line, scaled to current ruler settings, as it's being drawn or after it's been created
- Anti-aliasing ensures smooth curves, lines, and text

The Drawing Area:

- Unlimited drawing area
- The drawing area automatically resizes to fit drawing

Lines:

- Choose any line style: straight, arc, segmented, curved, double lines, filled lines, or create your own. Connect lines to create custom shapes.
- Lines do not intersect unless you want them to
- Click - let go - click line drawing
- Automatic spacing and sizing of connectors
- Draw dotted, dashed, and filled lines and borders as thick as wanted
- Size and move lines with the mouse
- Lines and curves automatically change shape to maintain connections between shapes

Text:

- Text automatically formats inside or next to any symbol or shape
- Built-in spell checker can be set to automatically check spelling as you type, or used separately
- Add words to your custom dictionary

Tables:

- Choose from pre-formatted tables
- AutoFill automatically populates header cells with numbers or dates
- Add symbols and photos to cells
- Specify border and background colors for each cell or the whole table

Customization:

- FreeForm drawing tool lets you create your own shapes, lines, and arrowheads
- Edit existing symbols to define text placement (inside it, under it, etc.), where connections can be made to its borders, and how it will resize when stretched or scaled

Colors, Borders and Effects:

- Change the color of the symbols, lines, and backgrounds within your drawings

- Save time by capturing the style from any object in your drawing and applying it to others with one mouse-click
- Apply pre-defined themes to your entire drawing, which automatically control colors, textures, styles, and backgrounds

Printing:

- Anything your printer can handle, SmartDraw can output, from standard sizes to poster prints

Compatibility:

- Works seamlessly with Microsoft Word, Excel and PowerPoint, and move files and data

System Requirements:

- Windows 2000 or XP

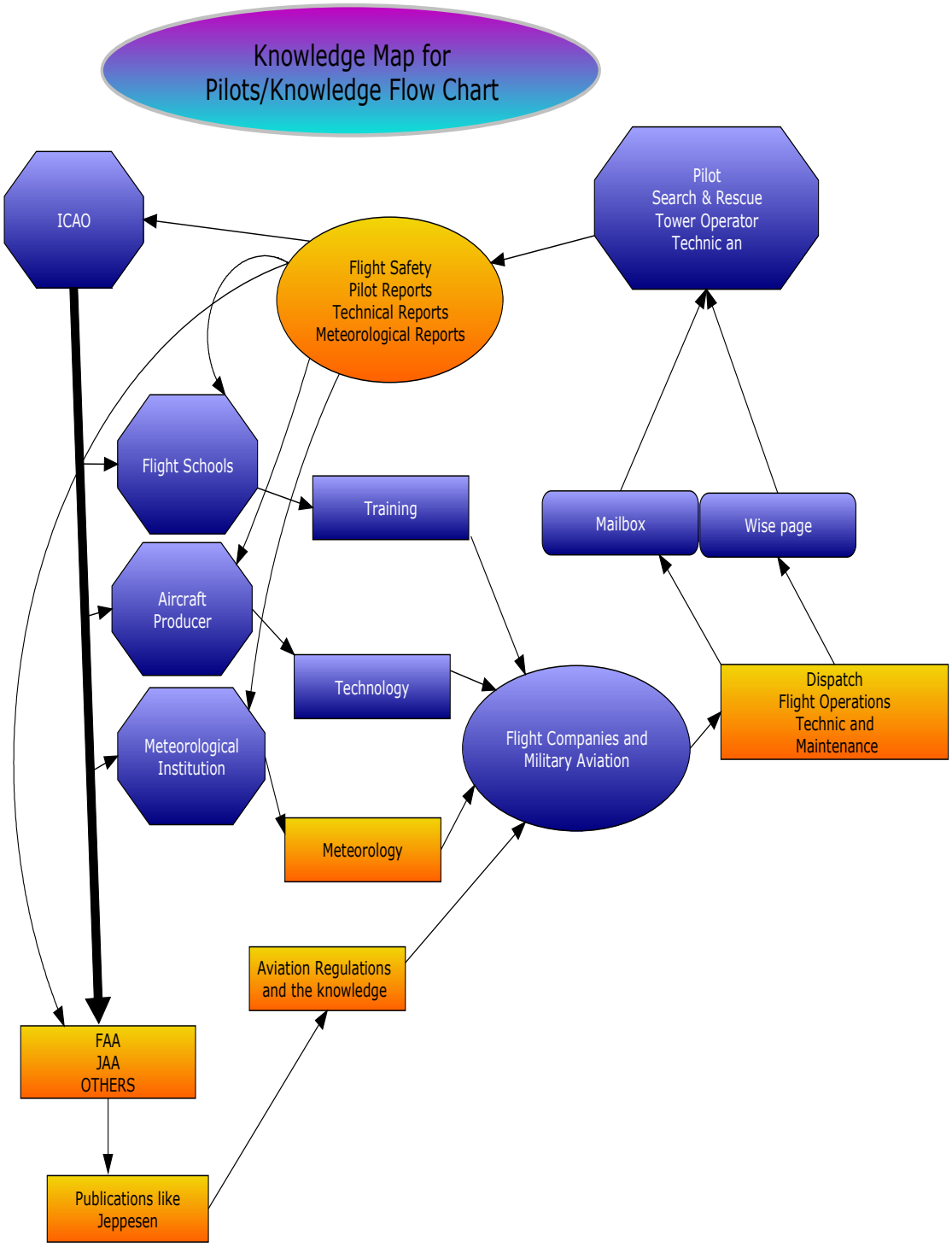

Figure 4.6 : Knowledge Map Flow Chart that was produced with Smart Draw Mind Map

4.8. Visual Mind

Mind Technologies started developing Visual Mind in 1998, and has since continuously improved its software. Visual Mind is used for a variety of purposes, and surveys among users indicate that planning/preparation, brainstorming, making meeting notes and to-do lists are among the most popular areas of use. [32]

Visual Mind increases user's capabilities and improves user's efficiency through simple graphical techniques. Keeping track of an increasing number of different tasks, and prioritizing them correctly, influence performance as a business professional. Making decisions, minor or major, project oriented or as part of a strategic planning process, tend to follow the same basic pattern. Visual Mind is flexible enough for minor decisions, yet allows the development of decisions trees etc. for major decisions. [33]

The graphical techniques allow users to easily and quickly share information and thoughts. Brainstorming is a lot easier when participants can share the same graphical view throughout the whole process. Arranging and structuring the ideas becomes even easier as user utilize the built-in functionality of Visual Mind. [33]

Inspired by the renowned "mind mapping" study technique, Visual Mind improves ability to learn and help students clarify thought processes. Utilizing the mind's ability to understand and remember visual information is a key element in the mind mapping technique. Visual Mind provides a graphical user interface that combines flexibility with structure.

Visual Mind Editions:

There are two editions of Visual Mind available:

- **Business Edition:**

The Business Edition includes the powerful functions for professionals users, businesses and teams. Full range of export / import capabilities including, distribution and publishing functions that allow easy sharing of maps with co-workers clients and project teams.

Both map explorer and search functions make it easy to manage large and complex maps. If the maps contain sensitive information,consider using the password and encryption functions. It was ranked on the list as third with a score of 2,48.

- **Basic Edition:**

The Basic Edition is designed for individual users who wish to focus on the core mapping functions of Visual Mind. If the maps are modest in size and complexity, the Basic Edition may cover the needs. Some features are excluded in this edition and, both business and basic editions have the same user friendly graphical interface. It is possible to use and evaluate Visual Mind for 30 days free. [32]

System Requirements:

Pentium processor

Windows 98/Me/2000/XP

64 MB RAM

30 MB free hard disk space

Instructions for downloading the software: click on your desired language to download the installation file. Save the file to your local hard disk. When the download is complete, open the downloaded file (visualmindsetup.exe) in Windows Explorer to start the installation. When the trial period of 30 days has expired, you need to register your copy on the Visual Mind order page to continue to fully use the program. Visual Mind 8, Business Edition price is USD 229.00 and Visual Mind 8, Basic Edition price is USD 99.00.

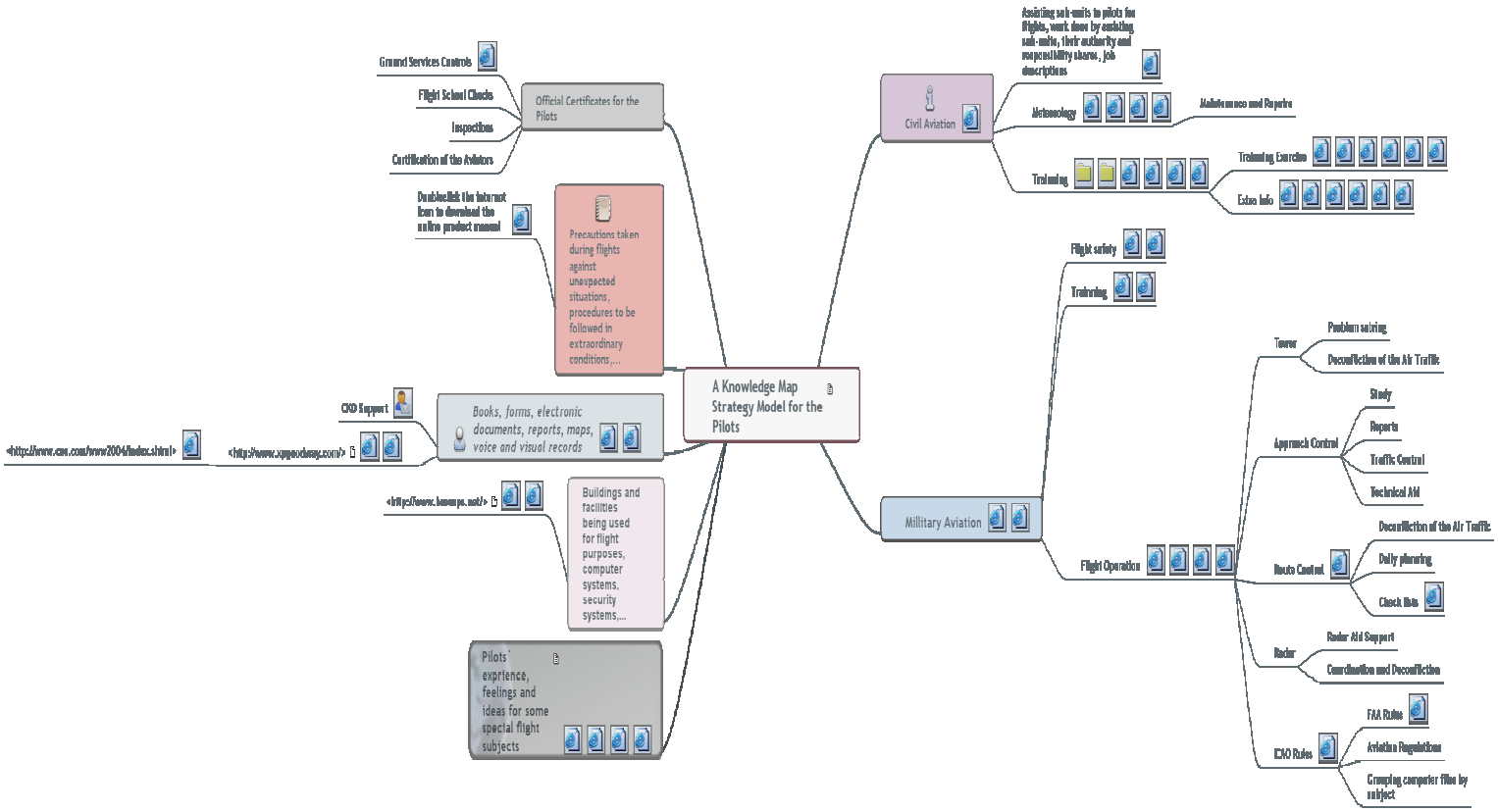

Figure 4.7 : A Knowledge Map Model which was Created for Pilots with the Visual Mind 8 Software

4.9. Evaluation

When it came to evaluating mapping software, all mapping software were searched that could have been find advertised or reviewed on the internet. And two basic criteria were looked at:

- Was there enough information available to do an assessment?
- Could the software be downloaded on a trial basis?

Then software packages were divided into 3 groups:

a. General Concept Mapping

b. Mind Mapping

c. Unique (software that claimed to do both concept mapping and mind mapping, or software that appeared to have other unique characteristics). [33]

a. General Concept Mapping [21]

- Conzilla free : basic concept mapping software.
- IHMC CmapTools free: the Novakian concept map modelling software.
- Inspiration v.7 $149.00 : the standard concept mapping software.
- MindFull $100.00: stores information in folders; not much flexibility; resembles note-making software.
- SmartDraw $197.00: basically a charting and diagramming software with concept and mind mapping built in; lots of templates, lots of options, very flexible.
- SMART Ideas $59.00: looks very much like Inspiration.
- StarThink $100.00: basic post-it note style thought organizer for writing.
- Axon Idea Processor $165.00: has both concept and mind mapping capabilities. the user showcase of ideas is impressive.
- Inspiration v.8 $149.00: originally reviewed for concept mapping, but v.8.0 appears to have mind mapping capabilities too.

b. Mind Mapping [21]

- Aviz ThoughtMapper $59.00: similar to Freemind, but fewer options.

- Brain Mine $52.00: similar to Mind Mapper.
- ConceptDraw Mindmap $310.00: intrigueing software, with a strong drawing base; most flexible software no trial download.
- Creative Thinker $114.00-167.00: uses hexagon modeling; looks like a brainstorming software in hexagons; very expensive for what is seen on the website;
- Crystal Maps $99.00: described as a type of mind mapping software, using concentric circles and pull-outs.
- DeepaMehta free: a semantic map, a networked semantic desktop, a topic map;
- FreeMind free: basic mind mapping getting better with each version
- HeadCase $100.00: interesting software to simulate hand-drawn mind maps; still in in beta testing mode.
- KDissert free: similar to Freemind.
- Map it! $58.00: similar to Mind Mapper.
- MindGenius $247.00: has almost everything Mind Manager has; better graphics; better output options.
- MindManager $ 630.00: expensive.
- Mind Mapper $180.00: basic mind mapping software; has a few nice features that more expensive packages lack.
- Visual Mind $ 299.00: Similar to MindGenius and Mind Manager, creates better templates.

c. Unique [21]

- 3D Topicscape $49.00 Special, Regular $149.00: has a very unique display; program is really practical for many things.
- Aibase $64.00: knowledge builder, brainstorming tool, learn helper, outliner, vector graphics editor; but it really doesn't seem to be designed for traditional concept mapping and mind mapping.
- PersonalBrain $80.00: certainly different, but closely resembles the display technique developed by Thinkmap; worth exploring further because of its unique format.
- Thinkmap $5000.00: makes the Visual Thesaurus; too expensive.

Some packages were just too expensive for what apparently was being offered and were ignored. For products that appeared to be of equal quality, options and features were looked at, based on the promotional material, and selected the software that appeared to offer the best options, without any cost.

5. CONCLUSIONS

The deficiencies in aviation knowledge source management is a serious problem. Everyday new challenges in knowledge exchange for pilots are emerging. [33] It is important to find out what pilots` needs are, then draw a logical model which links those needs. An intuitive system and adequate methodologies to achieve this should be decided. Too much information, too quickly changing in too little space and time, is causing conflict. Pilots should be provided with the correct aviation knowledge in order to fulfill all kinds of flights safely and successfully in both national and international environments. Information can be exchanged smootly to create a knowledge source or knowledge flow for pilots. Some of the potential benefits are improved operational performance, solutions to large inefficiencies and improved mission readiness. With these improvements the potential for flight operation in the future is a possibility. In organizations knowledge maps have the following functions:

- Finding out: In all formats continuously developing related knowledge collection. [34]
- Organizing: Organize the knowledge of organization.
- Sharing: In all levels of organization, knowledge is being reachable in an appropriate way.
- Development: Knowledge maps are being more beneficial and stronger by newly added knowledge.

The knowledge map reduces the operational burden on flight units and companies by aggregating the software and hardware at central locations. This provides the capability to upgrade the system without the necessity of physically upgrading the data input or processing devices at the flight unit.

The near-real-time aggregation of flight data in a centralized database will allow queries at each echelon of supervision. [35]

The benefits of this are twofold; the knowledge is available when needed for decision-making purposes and the flight company is not tasked with excessive report generation requirements when ad hoc reports are deemed necessary. [36]

The near-real-time availability of knowledge about both training and maintenance will allow trend analysis and the ability to address issues in a timelier manner along with providing details needed to make decisions about unit or airline company employment. The flight operations and flight company leadership would spend considerably less time responding to standard and ad hoc report requests, allowing them to focus on leadership and training.

Some other findings are as follows:

Criteria for critical knowledge has to be identified. How will the knowledge be processed? [37]

For example check list change is a critical safety matter. How will it be changed?

What does a pilot need to know? What critical knowledge must be pushed to the pilot?

After pushing this knowledge it has to be confirmed that pilot has received the knowledge and is using it. Means should be identified to confirm the knowledge check. [38]

For example : Has the pilot checked the NOTAMs?

Has the pilot checked the Meteorology?

There should be a control mechanism which reveals that the pilot has the knowledge.

A control tool must be used for critical information in controlling and confirming whether or not the knowledge has been received by respective people.

What knowledge is critical?

Which knowledge will be forwarded to the respective people?

For these issues classification of the knowledge and prioritasion of the knowledge becomes very important.

The frame work for knowledge management has to be set.

How will knowledge management work at the right time and how will it be processed? [39]

Knowledge management staff is required if time is not a factor.

Managers must identify the requirements and they have to direct what knowledge will be in the knowledge map. (i.e. who needs what information and when?)

From the pilots' view:

- There are a lot of tools.
- How will these tools be operated?
- Which tool contains what information?

If pilots don't know where to find knowledge, then practical solutions should be offered in solving the problems:

- Change the mind set of pilots and organisation.
- Identify regulations (i.e. SOPs)
- Train the staff for the use of systems and knowledge management
- Responsibilty and procedures should be determined.
- Managers must know the contents of the knowledge otherwise they can not classify the knowledge. [40]

This is also related to the importance of the content.

In accessing knowledge:

- The problem is, it is difficult to access the knowledge.
- Where to click on?
- Problem for the user clicking on many buttons for finding the knowledge and it can take many hours of searching before finally leading you to a proper knowledge.
- There is a necessity to have a search engine within the system for identifying and accessing the exact knowledge in a very short time, otherwise it is very difficult to solve the problems.

The main deficiencies in aviation knowledge source management are too much information, changing too quickly, too little space and time. On an electronic system it needs to be available by intuitive selection.

The information exchange should be done in a knowledge map for creating a knowledge source or knowledge flow for the aviators especially for the pilots.

Not only for aircrew flying from well established bases, but also the ones that are flying in operation areas, knowledge maps could be very effective. In this system military and civil regulations, NOTAMs, meteorology, airfield data, aviation publications, books, manuals, journals, web sites, electronic data links, charts, planning tools, military and civil mapping, electronic and paper data for flight systems as knowledge sources should be available in order to help pilot in fulfilling flight missions successfully.

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APPENDICIES

APPENDIX-A QUESTIONNARIE 1.

1. Name: It is not obligatory to write your name

2. Surname: It is not obligatory to write your surname

3. Nationality:

4. Specialty or Post:

5. Aviation Background and Training:

6. What are your total flight hours in each type of aircraft?

7. What are your total flight hours for night flying?

8. What are your total flight hours for IFR flying?

9. What are your total flight hours for VMC flying?

10. What are your total flight hours for training?

11. What are your total flight hours as an instructor?

12. What are your total flight hours in a simulator?

13. What is your work experience as an aviator? How many years in total?

14. How do you think that the information exchange can be done for creating a knowledge source or knowledge flow model for pilots? (This information source can be as a library or as a web portal or web page.)

15. What is the most efficient flight simulator in general that you know for pilots for personal and unit or company use?

16. Which aviation sources (as in the category of the books) do you recommend for pilots to be prepared for any kind of flight?

17. Which aviation sources (as in the category of the manuals) do you recommend for pilots to be prepared for any kind of flight?

18. Which aviation sources (as in the category of the aviation publications) do you recommend for pilots to be prepared for any kind of flight?

19. Which aviation sources (as in the category of the journals) do you recommend for pilots to be prepared for any kind of flight?

20. Which Aviation sources (as in the category of the web sites or electronic data links) do you recommend for pilots to be prepared for any kind of flight?

21. Which flight planning support systems (Electronic and Manuel) do you recommend for pilots to be prepared for any kind of flight?

22. Which other knowledge sources do you use as a pilot in order to fulfill a flight mission?

23. Which flight planning map, GPS, Navigation system preparation do you recommend for pilots to be prepared for any kind of flight? Which maps are proper for planning (Electronic and Classic)?

24. How do you do your IMC flight planning? Please explain in a few sentences.

25. What are the most important dangers for the pilot? Please explain in a few sentences in general.

26. What are the problems for the pilots in reaching when they look for the aviation resources?

27. What do you think are the new challenges in knowledge exchange for the pilots?

28. Which subjects, lectures, topics, electronic data links, articles, manuals, technical books, air publications should take place in a knowledge exchange source model for pilots?

29. How should a pilot be provided with the correct aviation knowledge in order to fulfill all kinds of flights safely and successfully in both national an international environment?

30. How would you design a knowledge exchange source model for pilots to help in the preparation phase of flight missions? What characteristics should this knowledge model have?

31. Do you know any computer applications or programs for flight planning which cover all phases of the flights? What are these programs?

32. If you think that there are some other issues which should take place in the pilot knowledge exchange model please write here?

APPENDIX-B QUESTIONNARIE 2.

1. Please answer how you are agree with the explanations bellow written by checking the selections bellow listed which you are agree with .

Information exchange can be done for the pilots for creating a knowledge source or knowledge flow for the aviators especially for the pilots depends on what the nature of the flying is. For aircrew flying from well established bases, a knowledge map could be very effective.

a. Absolutely correct
b. Correct
c. Partially correct
d. I am undecided
e. Partially wrong
f. Wrong
g. Absolutely wrong

2. Please answer how you are agree with the explanations bellow written by checking the selections bellow listed which you are agree with . You think that a full-motion simulator is the best choise for emergency procedure practice.

a. Absolutely correct
b. Correct
c. Partially correct
d. I am undecided
e. Partially wrong
f. Wrong
g. Absolutely wrong

3. Please answer how you are agree with the explanations bellow written by checking the selections bellow listed which you are agree with .

You use Military regulations, civil TAPS charts, military and civil mapping, electronic and paper data for flight systems in order to fulfill a flight mission.

a. Absolutely correct
b. Correct
c. Partially correct
d. I am undecided
e. Partially wrong
f. Wrong
g. Absolutely wrong

4. Please answer how you are agree with the explanations bellow written by checking the selections bellow listed which you are agree with .

As in the category of the books, manuals, publications, journals, web sites or electronic data links you recommend for pilots to be prepared for any kind of flight to usage of Military/civil regulations for flying, flying techniques for types of flight, aircraft type manuals and regulations, engineering manuals, ATC publications, NOTAMs, Meteorology, Airfield data, calculator, mapping and charts.

a. Absolutely correct
b. Correct
c. Partially correct
d. I am undecided
e. Partially wrong
f. Wrong
g. Absolutely wrong

5. Please answer how you are agree with the explanations bellow written by checking the selections bellow listed which you are agree with .

You use electronic flight planning support systems (Electronic and Manuel) as a pilot to be prepared for any kind of flight.

a. Absolutely correct
b. Correct
c. Partially correct
d. I am undecided
e. Partially wrong
f. Wrong
g. Absolutely wrong

6. Please answer how you are agree with the explanations bellow written by checking the selections bellow listed which you are agree with .

You use for flight planning map GPS, Navigation system preparation to be prepared for any kind of flight.

a. Absolutely correct
b. Correct
c. Partially correct
d. I am undecided
e. Partially wrong
f. Wrong
g. Absolutely wrong

7. Please answer how you are agree with the explanations bellow written by checking the selections bellow listed which you are agree with .

Aviation knowledge sources should be available for all pilots on an electronic system it needs to be available by intuitive selection.

a. Absolutely correct
b. Correct
c. Partially correct
d. I am undecided
e. Partially wrong
f. Wrong
g. Absolutely wrong

8. Please answer how you are agree with the explanations bellow written by checking the selections bellow listed which you are agree with .

As a pilot, greater sophistication, more aircraft systems and greater complexity remove the pilot further from the basic machine: when these systems fail, the amount of knowledge that has to be retained mentally has increased significantly.

a. Absolutely correct
b. Correct
c. Partially correct
d. I am undecided
e. Partially wrong
f. Wrong
g. Absolutely wrong

9. Please answer how you are agree with the explanations bellow written by checking the selections bellow listed which you are agree with .

In order to prepare a knowledge map model for pilots you'd ask to the pilots what their needs are then draw a logical model which links those needs. This would be the basis of an intuitive system. There are plenty of adequate methodologies to achieve this.

a. Absolutely correct
b. Correct
c. Partially correct
d. I am undecided
e. Partially wrong
f. Wrong
g. Absolutely wrong

10. Please answer how you are agree with the explanations bellow written by checking the selections bellow listed which you are agree with .

All aircrafts can operate in airspace that is why there are some additional air trafic like OAT which are more related to the national aviation rules. So pilots have to be provided with also national rules besides ICAO rules.

a. Absolutely correct
b. Correct
c. Partially correct
d. I am undecided
e. Partially wrong
f. Wrong
g. Absolutely wrong

11. Please answer how you are agree with the explanations bellow written by checking the selections bellow listed which you are agree with .

The knowledge should flow with interaction between the some components like meteorology, ICAO, Jar, Millitary, Legal, Technical and the responsible aviation agencies like governmental agencies, updated as it is required and presented to the pilots via a comphrehensive knowledge map it also should include a wise page and mailing tool.

a. Absolutely correct
b. Correct
c. Partially correct
d. I am undecided
e. Partially wrong
f. Wrong
g. Absolutely wrong

12. If do you think that there are some other issues which should be take place in the pilot knowledge map model please write here?

APPENDIX-C FLIGHT OPERATION CERTIFICATE

REPUBLIC OF TURKEY
MINISTRY OF TRANSPORT
DIRECTORATE GENERAL OF CIVIL AVIATION

A member of the

JOINT AVIATION AUTHORITIES

Details of Mangement Personel required to be accepted as specified in various JARs.

1. Name : **Yakup ÇARKCI**
2. Position: **Flight Operation Manager**
3. Qualification relevant to the item (2) position :

- ***FIR (A)****396,* ***CPL(A), IR(A),PPL(A)*** *İssued by* ***THK***
- *TSE Quality System****(K-Q TSE-ISO-EN 9000)***
- ***JAR OPS*** *Training Certificate*

4. Work Experiences relevant to the item (2) position:

33 years.

Signature ..... / Date 04.05.2005

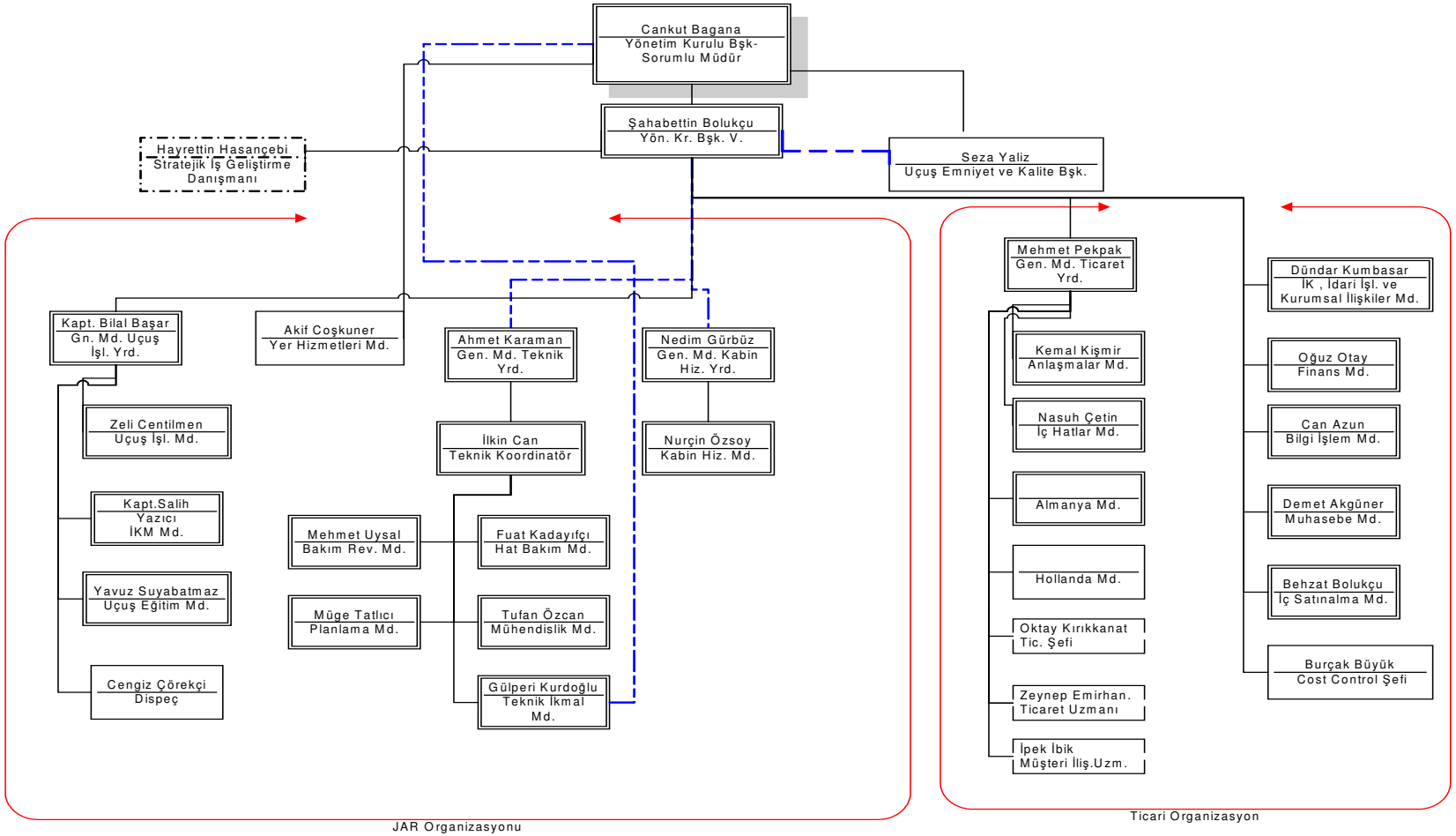
On completion, please send this form under confidential cover to theDGCA.....

Turkish DGCA use only

Name and signature of authorised DGCA staff member accepting this person

Signature. ..... Date.....

APPENDIX-D ORGANIZATION STRUCTURE OF ONUR AIR (JAR ORGANIZATION)



APPENDIX E

Free Mind Software CD Prepared for A Knowledge Map Strategy Model

AUTOBIOGRAPHY

Volkan İbrişimoğlu was born in 1967, Malatya. He graduated from Kuleli Military high school (İstanbul) in 1985 and he attended Turkish Land Forces War Academy, Electric- Electronic programme in the same year. Having graduated from the war Academy as a lieutenant in 1989, he attended the Army Aviation Flight School (Ankara) in the same year. In 1990 he graduated as a fixed-wing pilot and worked in different National Units of Land Forces. In 1992 he attended to rotary-wing pilot course in the Army Aviation Flight School. Upon graduation he worked in a number of National and International Units and Organisations. He also attended proffesional courses in USA, Germany and Russia. In 2004 he graduated from the Faculty of Law at İstanbul University. In the same year he started his MSc at the İstanbul Technical University Defence Technologies. Now he is working in NRDC Turkey as an army aviation officer with the rank of major. He knows English and Russian.