

# Knowing More about Knowledge Management at ESA

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**Abstract:** During the last years, ESA has gathered an extensive experience in Knowledge Management (KM). As a knowledge intensive organization, ESA pursues the efficient management of its expertise and know-how. In particular, it was decided to start a corporate KM project consisting of several pilot projects. The selected approach was built on pillars summarized in these four keywords: “integrated” (interconnection of its parts), “pragmatic” (concrete solutions compatible with the corporate culture), “business” (linked to the core business) and “open” (input and best practices gathered inside and outside the Agency). This paper presents the activities carried out within the set of pilots and the relations among them. These pilot projects are: iKnow Portal, Competency Management Tool, Expertise Directory, Knowledge Capture and Handover, KM Officer and Lessons Learned Harmonization. The future of KM in ESA is a challenge aiming at proposing integrated solutions in an environment with different cultures and several existing individual solutions. The achievement of it will certainly provide a better leverage for the institutional KM.

## 1 INTRODUCTION

Knowledge Management is a key pillar for the efficient evolution of knowledge-intensive organisations such as the European Space Agency (ESA).

ESA is in charge of promoting, developing and operating space missions (see [www.esa.int](http://www.esa.int)). The Agency has five establishments: HQ at Paris, satellite development at Noordwijk (NL), Earth observation programme at Frascati (I), operations at Darmstadt (D) and astronomy at Villafranca (E). It employs about 2000 permanent staff. The operations are carried out at the European Space Operations Centre (ESOC), Darmstadt. The coexistence of research, development and operations programmes makes ESA a knowledge intensive organization.

Since a few years ESA has recognised the crucial role of Knowledge Management as a tool not only to primarily preserve and share information and know-how, but also to help guarantee its own cost-effective and qualitative evolution. In order to achieve this objective, a corporate strategic approach to KM, in support to both the transversal and the

local nature of the Agency’s operations, has been defined and implemented.

This paper introduces the knowledge processes and tools which have been launched in different areas and identifies key challenges and opportunities to move ESA's knowledge agenda forward in a phased manner.

## 2 BACKGROUND

The KM topic has gained momentum at ESA thanks to a number of KM support initiatives undertaken by – and localised in – different Directorates.

Since the debate on the matter started, major steps have already been achieved in the area of knowledge management in ESA:

- At a general level managers and employees are conscious of the importance of KM, not only as a learning and development issue but also as a strategic and business related;
- A wide set of KM and communication technologies have already been developed;

- Some important KM practices such as lessons learned are to some extent applied to space missions;
- Operative knowledge is shared within some individual Divisions.

However, some outstanding issues are still not solved:

- Even if the importance of KM is evident, a culture of sharing and re-use it is not completely adopted in people’s mind and in business processes;
- The institutional knowledge base may shrink as individuals retire;
- New staff are immersed into new programs and expected to start working without a substantial introduction to the ESA history and processes;
- Knowledge explicit categorisation is missing and the evolution of competencies reflecting the objectives is developed in the heads of managers without adopting a systematic process and appropriate tools;
- Knowledge is often lost when staffs move to different projects/programmes without a proper knowledge handover process in place.

### 3 ESA KM STRATEGY

The ESA Knowledge Management strategy focuses on three major objectives:

- Capture, preserve and help evolving knowledge across missions and projects in order to increase efficiency, minimize the risks and avoid loss of expertise;
- Facilitate knowledge sharing to increase collaboration, synergies and, eventually, innovation;
- Set up methodologies and tools for people to find, organize, and share knowledge.

The first objective focuses on securing the gathered experience (i.e. Lessons Learned, Best Practices) and make it available to the community so that the proper knowledge is available at the appropriate place and time within work processes. Maintaining the existing knowledge provides the foundations to evolve with less efforts towards the new knowledge needed for future endeavours.

There is a large amount of knowledge generated during the day-to-day work from formal documents, reports, presentations to the less formal knowledge, such as information exchange between colleagues

that represents a significant and valuable part of the knowledge generated and accumulated. Actually, in most cases this knowledge remains in a tacit form, retained in the heads of the staff. When not formalized or made explicit, this knowledge naturally tends to be dispersed and eventually loses its value for ESA and its stakeholders.

The second objective focuses on facilitating the sharing of knowledge in order to increase the collaboration between individuals and teams. This heavily contributes to create a more fertile environment for continuous learning and for the search for innovative solutions. An effective knowledge sharing depends on how efficiently and effectively the knowledge is managed internally and how quickly it capitalizes on the skills and experiences gathered in the different functional areas of the organization.

Findings from interviews and brainstorming sessions with staff indicate that they need information technology to act on:

- *Search capability.* Documents such as reports or other types of information should be electronically searchable. Staffs want to be able to find a particular knowledge product with keywords and to be able to trust that it is the current version.
- *Ease of use.* Staff want knowledge to be well organized, to some extent summarized, easy to locate and easy to retrieve.
- *Access.* Staffs want to be able to access the information from the office or home.
- *Sharing.* Staff want to be able to exchange easily with colleagues information and knowledge products.

Box 1: Staff expectations.

The third objective focuses on helping people to access the information and resources they need to complete their tasks by providing the right KM tools, resources and methodologies. The way to find out which elements could build this objective was mostly the direct input of the people and brainstorming sometimes. Box 1 offers a insights on this.

A localised initiative started in the ESA Operation Center (ESOC), where a KM Core Team faced initial activities for the local achievement of the previous objectives. After some accomplishment, this team realised soon the benefits of introducing knowledge management ESA-wide. In view of maximising its positive impact for the users, it was important to minimise the effects of a too sudden methodological change. A solution to it was a

phased approach, taking into account the actual needs of the users and having pilot projects before any solution was proposed for application at corporate level. Moreover, if a local solution was already found available, the idea was to study its possible integration into a larger system without imposing structural changes to localised successful processes.

## 4 KM PILOT PROJECTS

In order to face the problem addressed above, ESA decided an approach based on two phases. The first one consisted on the analysis of the ESA as-is situation in terms of KM, in order to propose a set of pilot projects that would build the corporate KM system. The second phase was the effective implementation of the selected pilots from the previous phase.

The framework of KM selected projects and activities which have undertaken and launched consists of the projects listed in the next sections. A short summary of the objectives and goal is provided for each of them, whereas a more detailed description is dedicated to the KM Portal and the Competency Management.

In parallel to pilot projects, transversal activities were carried out with the goal to be informed of the state-of-the-art platforms and methodologies which would enable ESA to have a modern KM, serving its goals efficiently. To that purpose, it was strengthened the participation in KM groups (e.g. KM for Space - Google Group, Knowledge Managers from CNES and NASA), the contribution to the investigation of new methodologies (via collaborating in paper studies or creating their own research) and benchmarking new ideas for implementation with companies working on KM tools and methodologies.

### 4.1 iKnow Portal

The focus of this pilot was to improve a Knowledge Management portal (called iKnow) resulted from a localised ESOC work in response to the feedback from the user community. The areas identified for improvements were: interface look & feel and ease of use; performance; functionality extension by adding video transcriptions, search engine integration and mail to post mechanism.

### 4.2 Competency Management Tool

The scope of this pilot was to consolidate a

previously drafted competency management process and design a tool to support it. The result of this activity has been the presentation of a competency management process (supported by a tool), which covers the following objectives:

- Guarantee the availability of the current and future ESA competencies (knowledge, skills, and abilities) in regards to the ESA tasks that constitute ESA (critical) strategic capabilities and services.
- Provide a management support process and tool for identifying competency gaps, training opportunities and development plans on both short and long terms.
- Support the definition of the strategic objectives of the directorate.
- Allow an efficient maintenance and up-to-date overview of the related competencies.

### 4.3 Expert Directory

The aim of this pilot was to create a network between the ESA professionals, contractors and industry. The way to achieve that was the development of a platform that, interfacing with the competency management database, would provide a catalogue of people with their expertise.

### 4.4 Knowledge Capture and Handover

This pilot was selected to assess and propose possible mechanisms to be used to guarantee an effective capture of knowledge, tacit and explicit, in case of staff leaving for retirement or other assignment. The scope of the pilot is also to define a Handover Procedure.

The steps that were done:

- Analysis of KC events with respect to methodology and visual aspects.
- Proposal for capturing of experience.
- Proposal of a new way to present the KC events.
- Proposal of a Handover sequence.

### 4.5 KM Officer

This pilot was born with the objective to define the role, responsibilities and the functioning model of the KM Officer that could become the pivot of the knowledge management processes inside and outside the projects.

The actions taken regarding that were:

- Collection and assessment of the possible KMO tasks.

- Summarize the aspects of integration into the project.

#### 4.6 KM Awareness

The scope of the KM Awareness Campaign was to promote a Knowledge Management culture and to communicate in a smart way the KM initiatives. The deliverables have been:

- Communication Plan to choose topics to communicate, the media and the tone of voice.
- Video and Posters to promote KM.

#### 4.7 Lessons Learned

The objectives of this pilot project were the analysis of mechanisms and tools for the collection of Lessons Learned (LL) and also the dissemination of the Best Practices and Lessons Learned into the project database (with respect to efficiency and anomaly aspects) and across projects. To this purpose, the following has been achieved:

- Analysis of current ESA LL systems together with a comparison.
- Analysis concerning the collecting, managing and archiving of LL (compliant to the formal ESA process) with emphasis on description, transferability and sustenance.

### 5 MAJOR PROJECTS

This section describes on a deeper detail those activities related to the pilots which have a larger reach, that is to say, affecting the biggest possible amount of users.

#### 5.1 iKnow Portal

The iKnow was born to be the back bone of all the information at ESOC, more or less like an enhanced multimedia library, with forums, events, news and all relevant materials. Moreover, as the user is the one that creates most of the content, this portal is inspired by a “Web 2.0” approach for the knowledge management in ESOC.

The information that can be accessed from iKnow can be of very different nature, like relevant news, collaborative articles or any document and file indexed by the search engine or a link to an existing tool.

One of the main characteristics of this portal is that every piece of content (article, forum post, etc.) is assigned according to the group or community that it belongs to and also, to the tags that the author considered more descriptive (“free tagging” principle). So both methods are set by the user. Due to this, the content is categorized by the person that uses it and really knows what it is about, which guarantees that the knowledge is where it is expected to be.

In the context of this corporate KM project, the functionalities described in the next sub-sections were added to the platform.

##### 5.1.1 ESOC Search Engine

A commercial search engine has been running in a testing phase for a few months and now is implemented as an operational tool in ESOC premises. It is able to index a wide range of repositories without any customization of the tool.

In support to the idea of providing a single entry point to information, the search engine functionality has been integrated in the iKnow portal (Figure 1). The user can now enter a search request directly on the portal and get the results back from either the portal or all the other repositories indexed by the search engine.

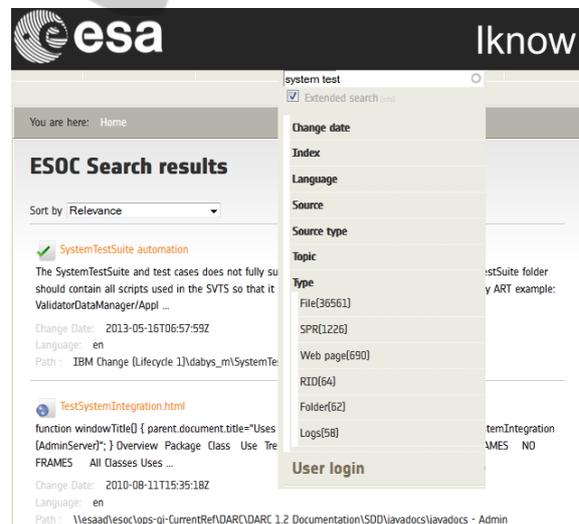


Figure 1: iKnow search engine functionality.

##### 5.1.2 Video Transcriptions

The video functionality was enhanced in iKnow to allow everyone to upload videos and optionally a transcription of them, such that they will be synchronized while the video is running.

In combination with the search engine, this is a powerful way of extracting the knowledge from videos. Once the transcriptions are indexed, the information will also appear in the search results.

### 5.1.3 Mail2post

This is a new feature in iKnow, made to facilitate the knowledge sharing by allowing the user to publish contents just by sending an email to a particular address.

With this functionality, users can easily share all the valuable information that otherwise would remain buried in the email box.

### 5.1.4 Expert Directory

In order to build a network of professionals closer to each other and to facilitate the identification of the necessary competencies, it was decided to create a directory of experts that would be validated by a formal authority inside ESA.

Therefore, it was agreed that the Expert Directory should use the Competency Appraisal database as its primary source of data. This database can be considered as a verified resource by Human Resources. The tool should only be able to explore the database or search through it for a member that has enough competences and present its data. No editing features were needed or had to be developed.

Though this started as an independent pilot, a module was developed and integrated in iKnow. After a successful development, any user could perform searches per competencies or knowledge areas. This module also provides with a view of the employee profile which would help, among other things, to design a training plan.

## 5.2 Competency Management

The Competency Management (CM) pilot project aims to develop a comprehensive and validated process that provides ESA a view as well as insight into the current and future required competencies. The process is expected to benefit different stakeholders such as Workforce Management and Training and Development programs.

The major objectives of CM have been reflected in activities included in the process and supported by the tool:

- Provide visibility of current and future competencies with respect to the roles that constitute ESA's strategic capabilities and services in general, and in particular.

- Make individual expertise better accessible within the organization. For this purpose, the focus is on staff specific competencies, i.e. competencies acquired by a person and not necessarily relevant for their current role(s).
- Allow the identification of competency gaps. For example, managers can get an accurate picture of the competency strengths and weaknesses of the staff under their responsibility and therefore assess potential competency gaps, criticality and competency coverage.
- Provide a way for an efficient competency maintenance and up-to-date overview, i.e. the workforce needs to be shaped and modelled to cope with desired future directions of the Agency, changes in technology, etc.

The process needs to be supported by a CM Tool structured such as to guide the different actors in the fulfilment of their relevant CM activities. Figure 2 illustrates this process.

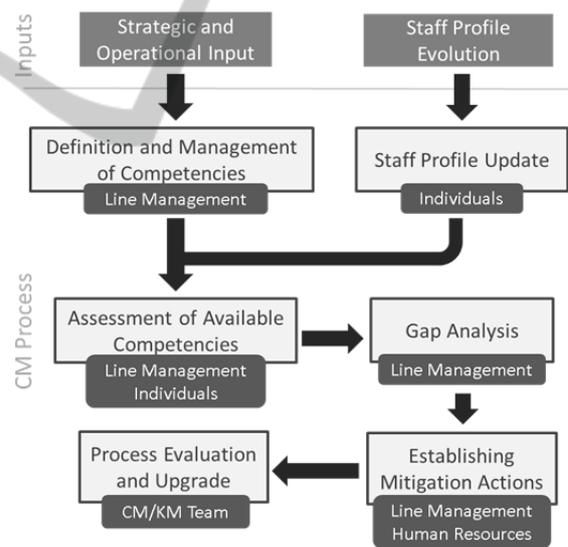


Figure 2: CM process.

At each cycle of the process, an iteration with the KM team will be also considered for addressing future management needs and process improvements.

The tool will support sequentially the different steps allowing the different actors to interact through the tool at the common goal of providing the current picture of the organisation and at the same time highlighting the area where improvements or actions are necessary. The same tool will provide high

management with summary report for an overall analysis of matching between objectives and current assets identifying possible gaps.

Once the process was consolidated, the main requirements for the tool were clear:

- Maintain a central repository of the CM related data, including both the definition and management of competencies and roles, and the information from the assessment. The repository will store historical information in order to keep track of the evolution over time.
- Support efficient introduction of data by users, manually using forms, and automatically from batch files or other formats.
- Offer a web based interface for multiple access with customized dashboard per user role.
- Automate the generation of the reports required as output of the different steps of the process.
- Implement the logic for the analysis of competence gaps, and proposal of mitigation actions.
- Offer a training plan specifying who needs training, what are the competences to be trained and the urgency of training.

Responding to the mentioned requirements, a market analysis has been conducted before starting any development. Since the CM process was still not stable and very likely to change as effect of this same pilot, the analysis suggested to take the approach allowing the highest flexibility and lower cost in performing modifications. In house implementation was selected, also facilitated by the existence in the Agency of a previous suitable tool already developed, though for other purposes (BIRF - Business Intelligence and Reporting Framework - built over Java Enterprise Edition platform). The existing tool based on a multi layered design could be strongly reused in the following generic components:

- The Extraction, transformation and loading (ETL) process responsible for the batch loading of the input data files (e.g. Excel) in the Data Warehouse, performing necessary adaptations.
- The Data Warehouse as a central data storage based on a relational database management system.
- Web browser based clients, which allow users to access the application from any location and device through the network

- The web interface for providing the user level functionality, and divided itself into three layers:

- Third party components, providing general purpose functionality by integration of open source libraries (e.g. web framework, chart libraries, reporting library, etc).
- Data analysis and reporting framework, providing generic application level components supporting all the required functionality (e.g. dashboards, report generator, security, data querying, etc.).
- CM customization, implementing the adaptation of the reporting framework to the CM process (e.g. adaptors, data model, user interface layout, etc.).

The design of the tool is taking into account future integration with other ESA platforms, in order not to duplicate information and realise better synergies. In this case, examples are: Workforce Management software, eLearning platforms, or Expert Directory.

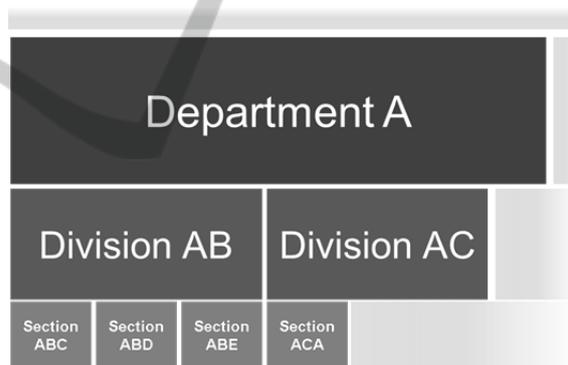


Figure 3: CMT Validation Units.

A validation of this pilot is being carried through one department of the organization. In ESA a department is divided in divisions and each division in sections (see Figure 3). A bottom-up approach has been chosen to validate the tool, starting from sections and aggregating the information until reaching a department level. For the time being one division composed by three section has been completed where few interesting conclusions were taken, as an example, what are the most predominant skills inside each unit. In the meantime the validation in other divisions started but still not completed.

### 5.3 Knowledge Capture

Knowledge Capture is not a new activity; it was already followed up during the past three years with about a dozen of events. Two methods were considered, the expert debriefing and the interview. They are not oriented to factual results of project phases but to personal experience gained by a staff within a long duration (either at the termination of a task or at the end of a position).

In brief words, the knowledge capture procedure consists of four parts: the review of the status (knowledge, expertise), the planning and the conduct of the expert debriefing / interview and the documentation. The expert debriefing is a kind of forum / workshop in order to allow the expert to explain the specialized knowledge for a selected range of topics to a larger group of participants. The goal of the expert debriefing is twofold, the expression of the underlying expertise in a verbal interaction with the audience and the recognition of the expert's merit. The participation in the interviews would be very limited, i.e. the expert, the moderator and a few members.

#### 5.3.1 Knowledge Capture Procedure

In some more details, the knowledge capture procedure consists of (Mugellesi Dow, 2010):

Step 1: Review of status with an inquiry. The objective is to assess the important knowledge subjects of the leaving staff as well as the knowledge demand required by the group and the successor. For the identification of the essential knowledge items to be captured different viewpoints (e.g. different role) should be adopted in addition to the chronological review of the supported projects. The quality aspects could be another perspective such as best and worst practices, contribution of the success and mistakes leading to a possible failure.

Step 2: Plan for debriefing and interview. This includes the sequence of knowledge subjects for the debriefing / interviews and its structure.

Step 3: Conduction of the Debriefing / Interviews with the goal of capturing the tacit knowledge and to facilitating its documentation. The various viewpoints mentioned for the first step above has to be adopted for the conduct of the expert debriefing and the interviews as well.

Step 4: Documentation (including the transcription) of tacit knowledge.

#### 5.3.2 Knowledge Capture Events

Knowledge capture events are video-recorded, last about 90-120 min. and comprise several sub-topics followed directly by a question and answer session. The sub-topics should not explain explicit knowledge (easily found in text books) but should go more into the direction of experience or knowledge not easily found in literature.

Some more explanations should be added for the better understanding of the capture events at ESOC.

- The duration for the expert debriefing is limited to two hours. This seems to be adequate as the expert debriefing is additional to the standard handover procedure. Furthermore about four to five subjects are selected. Another reason for the short duration lies in the assumption that with increasing duration the interest in participation will decrease.
- The choice of the four subjects depends on the relevance of the gained experience for the department / organisation. Normally two topics concerning specialized knowledge and two concerning experienced knowledge are selected.
- The group of the participants is decided from case to case depending on the topics and the envisaged subsequent discussions. In case of detailed discussions the group of participants should be limited as the intensity of the discussion will decrease with increasing participation.

#### 5.3.3 Capturing Experience (Erlach, 2008; Katenkamp, 2010; Pallaschke, 2011)

Recently, the handling of the experience was further investigated. Since more than a decade the value of storytelling for the transfer of knowledge by experience has gained in importance. Stories can better describe the complexity of reality than any theoretical explanations. Stories are important as humans think in narrative structures and often better remember facts in story form. The application of storytelling in knowledge management gains more and more in importance. Several companies have tested this method and use it. Knowledge by experience is considered as a central resource for the conduction of organizational processes. The four steps (as mentioned above for the capture procedure) will also remain for the case of storytelling. Knowledge by experience cannot easily be discovered with the help of the appraisal results.

Knowledge by experience requires in addition interviews with the leaving staff, the superior and the group. The aim of the narrative interviews is to explore how the experience was developed and how it was applied. Of course, the outcome of the interviews needs to be analysed with the help of associations for identifying the underlying experience. Structured interviews could follow for the better understanding of the experience. Whereas the planning (step 2) will remain unchanged, the actual conduct of the event (step 3) will include narrative methods. Narration cannot be compared with explanations (rational descriptions), they are feedback-oriented dialogues, the audience needs to conduct its own reflection for drawing the conclusions.

## 6 PROJECTS PILLARS

The individual pilots provide powerful solutions on the scope they have been designed for. Moreover, there is a more holistic view to regard the project as the integration of its parts. One of the principles on which the corporate KM project was built was the “Integrated” approach, that is the whole project has a meaning when observed as a unity instead of as many subsystems.

Each of the pilots is connected in some form or another to the rest in a way that if this connection would not be available, the functionality of each of them will be significantly decreased.

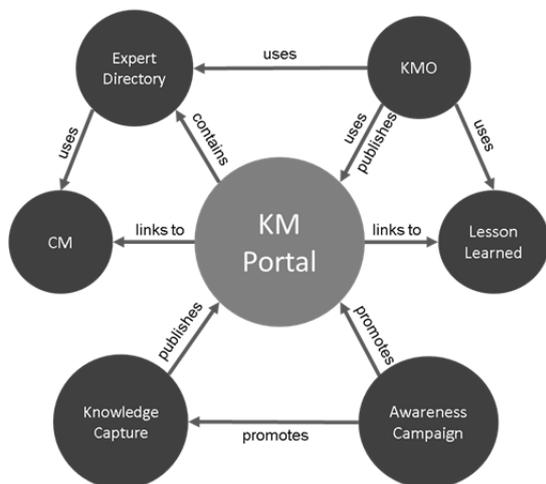


Figure 4: Integration among pilot projects.

Just to quote some examples extracted from Figure 4: the Competence Management tool

provides the input to the Expert Directory. At the same time, the Knowledge Management Officer can use this information to either request help for a project or to propose a Knowledge Capture event based on the available experts. The KM team would take care of this event and once this is performed and processed, the videos and materials would be uploaded to the KM Portal. Finally, through the awareness campaign the people would know that the portal includes such information and would be inspired to share more.

The “Pragmatic” approach is currently the main way at reaching goals in the KM at ESA. The resources available are very limited and only by implementing concrete and simple solutions the end of a pilot is reached. The adoption of this approach is often characterised by the need of simplifying or tailoring the solution, in parts that shall not limit the scope of the pilot. The simplification taken are tracked so to be later considered in case of a future corporate complete solution.

Every time a pilot is started, the “Business” approach has driven the activities at identifying first a concrete local interest without forgetting the need of a scalable design to make it suitable for future extension at corporate level. The local interest ensures the reaching of a good level of maturity since derived by a real case study with a clear and short time need. Later on the collected real data, facilitate the leverage at making it corporate.

The last, but not the least, pillar is to be “Open”. The KM team shall always work in collaboration with users and must minimise impact to processes, especially to the successful ones. Input and best practises are the input to any KM activities, since those are the key for addressing real and practical need and later on to be well received when presenting solutions and support.

## 7 CONCLUSIONS

Achieving the knowledge management objectives is pivotal to the Agency's efforts to reach its goal of cost effectiveness and risk minimization. Knowledge management is an ESA-wide initiative that requires strong leadership and commitment at every level, effective incentive mechanisms, ownership by all departments, offices, units, and active participation by all staff. Moreover, it requires a change in how ESA knowledge is perceived and supported.

The benefit of implementing the KM framework of projects presented in this paper will be the overall improvement of processes and mechanisms for

capturing, sharing and storing information, leading to an increased operational efficiency and facilitating innovation.

The project here presented sets a milestone on the history of KM for ESA since it comprises the first Knowledge Management system developed at corporate level. There are two remarkable facts: the first one is that the pilots comprising the system are covering areas of very different nature, demonstrating the big spread of KM in an organization; the second one, is the fact that the integration of the different parts into a single framework is perceived more efficient by managers and easier to be used by the individuals.

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