Introduction of a Workflow Tool in Support of Information Management within a Flight Test Organisation[*]

Dr.-Ing. Hans-Christoph Oelker
EADS Military Aircraft/ Flight Test
Rechliner Straße
D-85077 Manching

hans-christoph.oelker@eads.com

ABSTRACT

The challenges of changing markets have an impact on a flight test organisation typically orientated at military aircraft as well. To cope with these challenges at EADS Military Aircraft Flight Test a workflow tool in support of process enhancements and refinements was introduced. In the present paper an overview about resulting activities at EADS Military Aircraft Flight Test Centre is given.

The project was executed in a stepped approach with a process analysis through external consultancies in the beginning, introduction of a workflow tool for the flight test backbone process as second step, and possibilities to further integrate process elements as future options. Within the backbone process Test Task issue, Fight Test Programme, and Flight Card generation were considered. Flight Test specific aircraft configuration control was established as a necessary supporting process. – The tool is realised with state of the art software technology (common data base system with WEB technology user interface) in order to provide maximum flexibility (incorporation of different engineering programmes, maintenance efficiency) and tool support independently of testing location.

Overall process experience is positive. Process enhancements are clearly visible and transparency of process know-how will make past experiences easily accessible for future projects. It will be achieved through continuous utilisation of the workflow tool and continuous storing of facts and experience. Thus, powerful means of information management to share knowledge and experience are provided to a Flight Test organisation.

1   INTRODUCTION

Challenges of changing markets are an important boundary condition, also for a flight test organisation oriented typically at military aircraft. Methods and ways are required to manage all necessary test information in an efficient and orderly course. In addition, these methods and tools should provide the organisation with the possibility to preserve project experiences for new projects and have these launched with an easier start. Steady and fast evolving information technology tools support these tasks. Therefore, at EADS Military Aircraft Flight Test a project was initiated to support a process refinement with the use of modern information technology tools.

Supporting measures for an orderly and efficient course of actions require a common working infrastructure in order to provide all process participants with the same working environment. In a flight test environment with different projects running at the same time flexibility of this working environment is vital. This includes also flexibility in support to new projects with new boundary conditions. The necessary infrastructure must also be available to off-site test campaigns.

Due to the special nature of flight testing as the final step in a development programme (this nomenclature includes upgrade or small programmes as well) special attention on all actions is taken. This, on one hand induces a large need for efficient information exchange in many directions, involving many interfaces of different nature. On the other hand, established procedures to retain flight safety as the most important feature must never be compromised.

On the basis of these conditions the present paper will give an overview about current workflow tool activities at EADS Military Aircraft Flight Test Centre. These are aimed at providing a common tool for information and knowledge management to support the execution of flight test programmes during day to day routine work. Thus, within the scope of this Symposium "Flight Test – Sharing Knowledge and Experience" the presented paper will highlight a rather practical background enhancing knowledge conservation, its availability and transfer to new projects.

At the very beginning of the project a decision was taken to conduct a process analysis in order to better understand the given task. Within this decision process the possibility to take external advice and experience was considered. A good reason to follow this proposal was to gain an unbiased and objective view of the own organisation and its processes. Therefore a two stage approach was agreed upon: At first an analysis undertaken by a student team within the course of a diploma thesis was initiated. Their task was restricted to a certain part of the flight test organisation and processes. It was a low cost approach, managed internally, and was aimed at gaining initial experience with process analyses.

In a second step an external consultancy with special flight test experience was involved. With utilisation of results and experiences of the first study the analysis task was extended to the entire flight test organisation with all processes involved. Besides processes also organisational and cost issues were reviewed. Finally, all achieved results served as a basis for a decision on how to proceed with the realisation of identified measures.

In the following, major results of both studies will be highlighted and the resulting tool to support the content planning of the flight test backbone process (to be defined downwards) will be introduced in its basic structure. Finally, a summary of experiences gained during the project will conclude the paper.

2   PROCESS ANALYSIS

2.1   Analysis within Student Diploma Thesis

A team of four students from four nations within the ECATA Junior Programme (European Council on Advanced Training in Aeronautics) was installed with nationalities from France, Italy, the Netherlands and Germany. Educational background of all students was the equivalent of a master's degree course of studies. All four had to finalise their studies with their theses only. Three students had a background of aeronautical studies, whereas the fourth student had a background of management and administration studies. Co-operation with respective universities was good and all advisors agreed upon the execution of such a management processes orientated topic. – Overall co-operation within the team was excellent and all four students merged to an effective team very quickly.

2.1.1 Student Task

The work area of the student team was restricted to the engineering process of flight test (test technology and data analysis). Main reason was to keep the volume of student work within the scope of a diploma thesis. The time frame was limited to six months. Accordingly the following analysis steps were requested from the student team:

- establishment of a process map and documentation of interfaces to identify current process status

- opinion survey within the engineering department to identify needs for a more effective management of information and flight test data

- establish a concept for a Data and Information Management System (DIMS) based on the findings

2.1.2 Summary of Results from Student Task

Work performed within the student team at first was orientated at different technical disciplines. This means each one of the students was investigating a certain area on his own. These areas were classical disciplines (flight physics, engines, structures, and utility systems), avionics disciplines (communication and display, sensors) as well as weapon integration. This led to the establishment of an integrated process map for the flight test engineering process. For the requested opinion survey almost every engineer was contacted and gave his contribution. The willingness and alertness of everybody participating was excellent. Finally, the results from this survey were summarised in a concept for a Data and Information Management System (DIMS).

Main results from the students' survey were:

- different engineering projects (e.g. large development programmes) pursue the same processes with only minor differences on the lowest level

- a singular DIMS for all projects seemed to be feasible

  - still, the system to be realised required sufficient flexibility to account for differences in projects

  - compatibility with systems on the other side of interfaces was mandatory

- employees are mostly open to changes in data and information management tools

- clear indication of benefits will support change process

These results were considered as satisfactory so that a continuation of the analysis of the entire flight testing process could be started.

2.2 Analysis with an external Consultation Firm

External consultancy was considered the most appropriate way to achieve an analysis of the entire flight testing process, objective and non biased with own process views. A consultation firm with experience in flight test processes was hired. Main tasks for the analysis were identification of process redundancies and improvement potential. This included also a review of internal (flight test organisation) and external (outside flight test organisation, company internal as well as to the customer) interfaces and data exchange.

Major results were:

- explicit identification of improvement potential for organisational sub-units

  (e.g. interfaces, acknowledgement cycles, reporting cycles, …)

- delivery of "as is" and optimised process charts

- proposal for centralised information exchange (workflow tool) in order to harmonise processes and interfaces

Very shortly after finalisation of this study a partial restructuring of the organisation was initiated to successfully reduce interfaces. Another outcome was an intensive discussion about a centralised new tool to bundle all information exchange processes on one technology basis. A review of existing tools inside the flight test organisation and also of requirements for technical interfaces with external organisations (e.g. company wide PDM tool) led to the conclusion to introduce such a new tool for the flight testing process. This was considered to be the best way to be prepared for future challenges.

3   WORKFLOW TOOL

For the introduction of the workflow tool a stepped approach was considered. In a first step only the backbone process of flight testing (test content planning, to be discussed here) was considered. Further steps were not detailed at this stage. It was decided to first gain experience and then to continue with other processes of flight testing (e.g. analysis reporting, ...). For the realisation of the tool in this first step benefits were seen for further involvement of an external consultant firm. It was considered valuable to take benefit of their experience from other projects.

3.1   Resulting Concept for Realisation of Findings

The main reason of involvement of the external consultant firm was to take a benefit from their already available conceptual structure for a workflow tool and to adapt already existing software to local requirements. The intention was to keep specification effort as low as possible by using already available experience. In addition, together with the consultant a catalogue of technical requirements was set up. These were:

- "unlimited" availability of tool at all process interface locations

- no additional tool relevant software/ hardware requirements for work stations

- state of the art common software technology

- availability of growth potential for future projects

As a result from these requirements usage of a standard database application was considered to be necessary. A state of the art off-the-shelf product was selected, also to be compatible with company internal regulations. For the user interface requirements were developed which were aimed at keeping distributed special software (client-server solution) as low as possible. This led to the concept of realising the entire user interface with WEB technology via browser technology. Thus, the only software requirement on any workstation to connect to the new system would be a sufficient network connection and a WEB browser.

In the beginning this concept led to difficulties because company internal security regulations were not ready for highly sophisticated usages of the browser technology. At that stage of the project only simple HTTP applications were allowed, posing a severe challenge on the project. Negotiations with IT security as well as widely accepted more sophisticated usage of WEB technology led to a relaxation of IT security measures for known applications. This was a strong enabler for highly sophisticated technology to support the realisation of the workflow tool.

3.2 Tool Structure

For the first step during the realisation phase of the workflow tool functionality was concentrated on the backbone process of technical content planning. This includes (by definition for this project) the flow of information from a test request (Task Work Request, TWR, within tool terminology) via the flight test programme (FTP) to finally arrive at a flight card ready to conduct a test flight. Essential for support of this line of action is a reliable management of test aircraft configuration which includes specific management and tracking of all external store configurations and, moreover, all flight test relevant configuration changes to all systems present in the test aircraft. This backbone process is schematically described in the following Fig. 1.
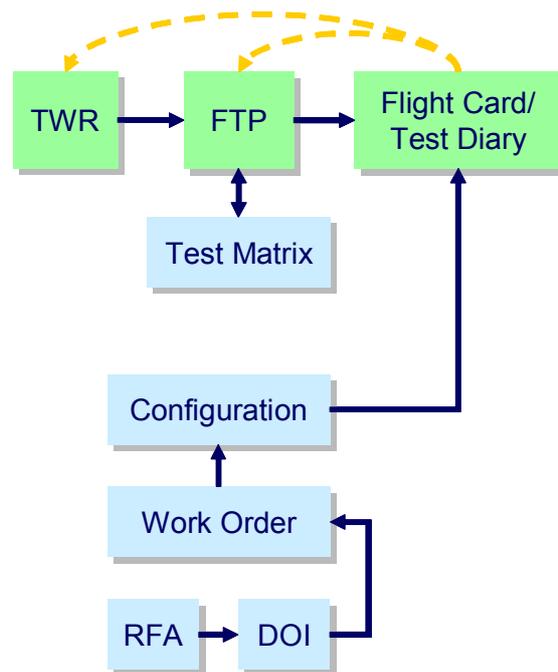
Fig. 1: Schematics of affected Backbone Process

Besides those already described elements of the backbone process (TWR, FTP, and Flight Card) it is indicated that the FTP module contains a test matrix module which is one important part of the system. This module contains all planned test points and within the total process allows for tracking of test progress on FTP level. The configuration management module is completed with a module for work orders allowing the steering of all configuration work within the production res. maintenance area of test aircraft. For this purpose special (already existing) working elements like RFA (Request for Alteration) or DOI (Design Office Instruction) are utilised. Efficient management of these was integrated into the workflow tool.

The following sections will highlight the internal structure of these modules.

### 3.2.1   Task Work Request and Flight Test Programme
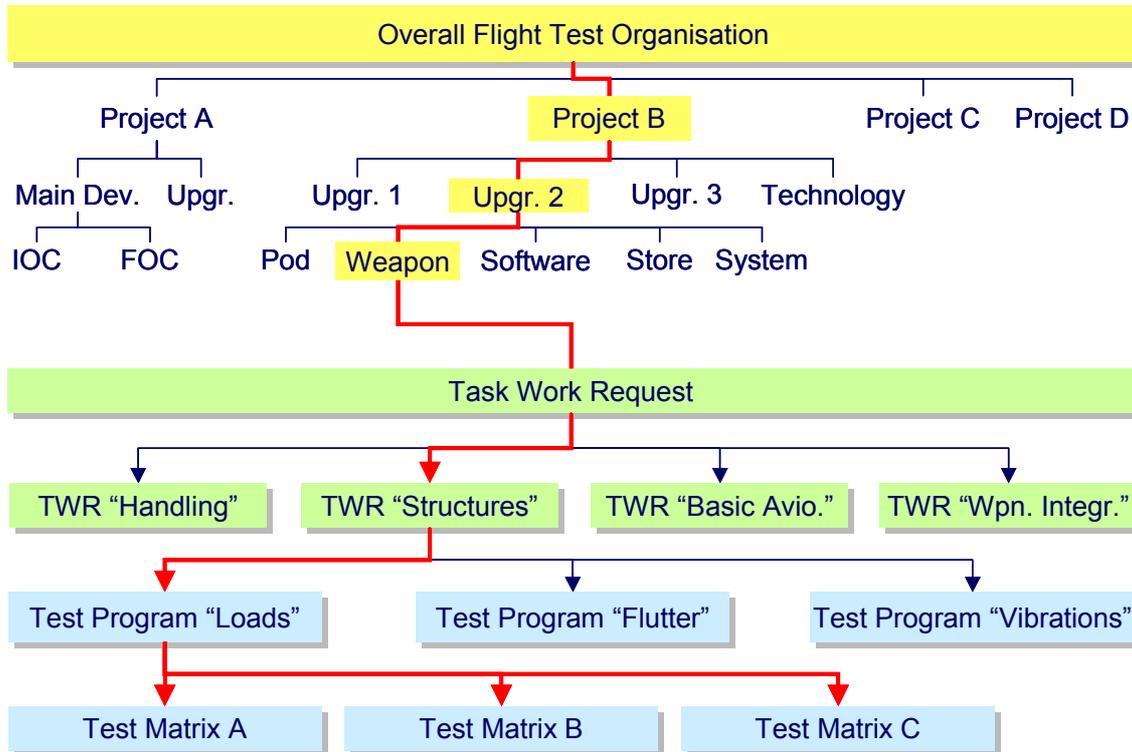
Fig. 2: Schematic Overview of Task Work Request and Flight Test Programme Module

Fig. 2 gives a schematic overview of the Task Work Request and the Flight Test Programme Module. In the upper portion of this figure a hierarchical structure of test projects is indicated. This can be a small project (e.g. Project C) which does not require any sub structures. Project A indicates a development and upgrade structure with different levels. As can be easily seen through the given examples this module provides management with many possible ways of structuring programmes tailored to specific needs. Actual tool flexibility opens much more levels (if necessary) than shown here. Based on the given project structure task work requests can be issued by management and assigned to the different disciplines. Each discipline (as an element within the tool structure) can cover several flight test programmes necessary to fulfil the required tasks.

An exemplary project structure path is given for an upgrade programme within Project B of Fig. 2. For an integration of a new weapon within a sub-project handling, structural, basic avionics as well as weapon integration tasks are necessary. Thus, for each of these disciplines a TWR is generated. Each TWR can cover several FTPs. As indicated for "Structures" three FTPs are needed and each FTP can contain several test matrices covering all required test effort.

This basic structure serves during test preparation for an orderly set up of all tasks. It may be difficult to convince people to take the (sometimes extra) effort to put everything into the tool at this stage. The advantage of it becomes only evident once the programme is running and a quick overview of test progress is required. Then data base functionality will serve this purpose basically on the "snap" of a finger. Moreover, for future projects of similar nature information about test effort and timely execution is readily available.

3.2.2 Configuration Management
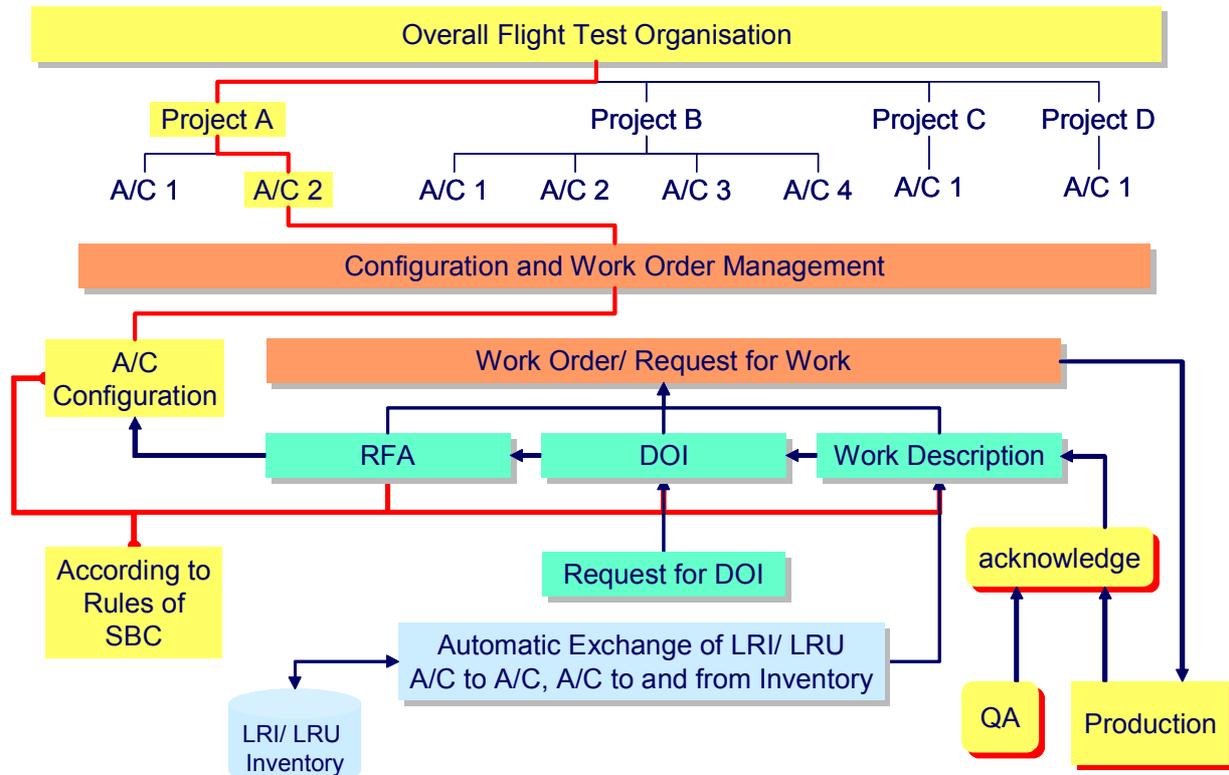
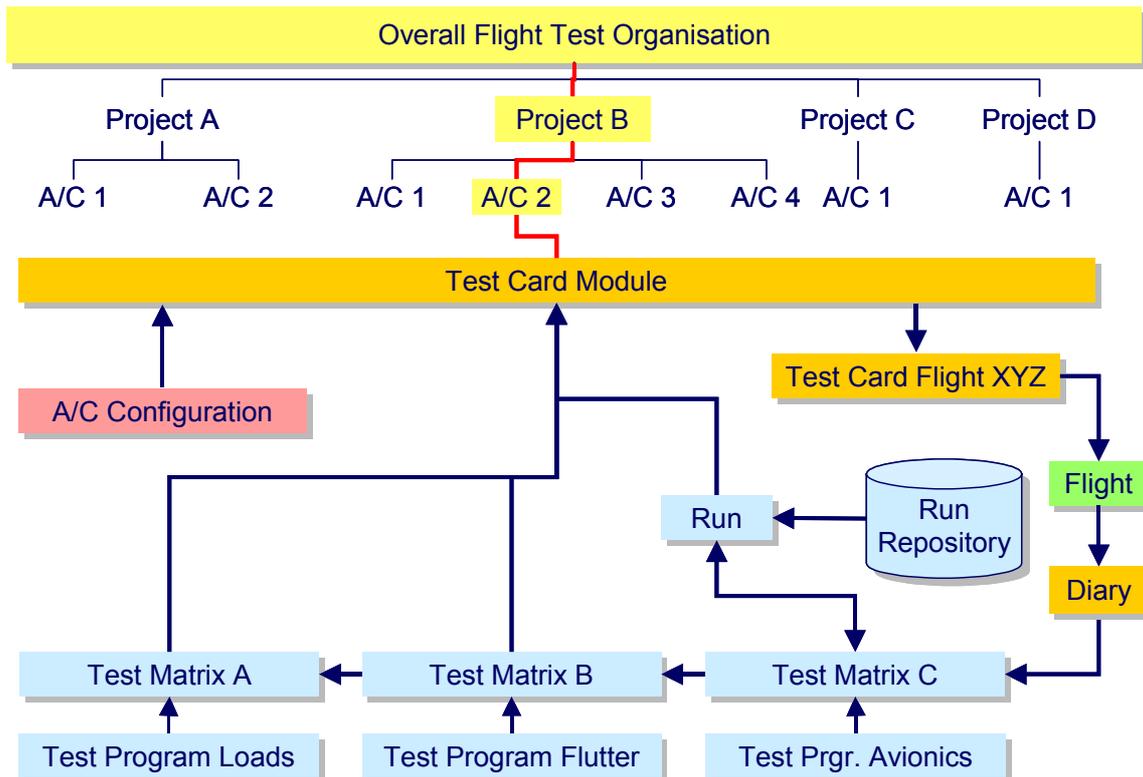**Fig. 3: Schematic Overview of Configuration Management Module**

Fig. 3 gives the schematic overview of the configuration management module. On the contrary to the TWR/ FTP module structuring (below top project level) is based on aircraft by their tail number and not on a given project sub-structure anymore. This acknowledges established working procedures to keep track on an aircraft. Main element of the configuration module is the Work Order or Request for Work. Within established configuration management processes this element is the key vehicle to initiate any change of the configuration.

A work order can be issued due to various reasons. One can be just a simple exchange of any LRI (Line Replaceable Item) which would be integrated into the work order via the Work Description element. Configuration changes of higher severity will normally be introduced via RFA or DOI (e.g. upgrade of system standards during the course of overall development). Once a work order has been completed and electronically signed and authorised by Flight Test an electronic message indicates to maintenance and production that a new order is ready. During the currently practised processes this work order will be transferred to a special tool in that area and processed according to the rules. When the requested work is completed acknowledgement from the maintenance and production area will be transferred back to Flight Test electronically. This action is the trigger for upgrading the configuration record of the specific aircraft within the workflow tool, thus, closing a specific configuration change action electronically. - Organisation of each aircraft's configuration record is according to established System Breakdown Codes (SBC).

Within established aircraft configuration control procedures at EADS-M at present this process is in parallel to the officially agreed and effective company wide controlled process. At a first instance this set up implies an artificially introduced redundancy. Nevertheless, process benefit is taken from it. For test

execution Flight Test is not interested in every position of a configuration control list of a test aircraft. Therefore, only those items are part of the workflow tool configuration management module which are of interest for Flight Test. For timely quick transportation of effective configuration changes to Flight Test the established official process is not as quick as the workflow tool. Thus, benefits are taken from this redundancy. Future changes of overall procedures and introduction of relevant IT tools companywide are expected to change this situation. For this case the Flight Test workflow tool is prepared already today to change accordingly.

3.2.3 Flight Card Management

Fig. 4: Schematic Overview of Flight Card Module

Finally Fig. 4 gives a schematic overview of the Flight Card Module. Again, organisational structure is orientated according to aircraft tail numbers. Previous modules feed their information into this module like it is indicated here for the configuration management module in a very simple manner only. Actual aircraft configuration information can thus be transferred directly into a flight card record.

Connection of the FTP module is more complex. Here a breakdown onto the test matrix level is available from the flight card module. This functionality enables the flight test engineer to directly pull any available test point from any available FTP into the specific flight card under consideration. When this process is practised the chosen test point is immediately marked so that everybody else working with the system knows that this test point has been selected. – For specific avionics and weapon systems testing test points are associated with test runs. In this case the test run is part of the flight card. Still, the affected test point is marked as used.

After completion of a test a flight card entry is transferred to the test flight diary. The main purpose of the diary is to have information of work done readily available for various reporting duties. – Test point

evaluation can be either done when the flight card is still handled as flight card or when it is already part of the diary. Test point evaluation marks each test point's status (flown, not flown, successful, not successful, repeat, and done) with direct feedback to the test matrix of the individual FTP. Thus, at any instance from the perspective of a FTP a report about current status of all test points can be made. – The diary also serves as an information pool for aircraft configuration as a function of flights.

3.2.4   Workflow Tool Integration into total Process

As discussed in the beginning the current workflow tool project will be executed in a stepped approach. Therefore, in this section prospective integration of the existing tool into the entire flight testing process will be described briefly. An overview of this planning is given in Fig. 5.
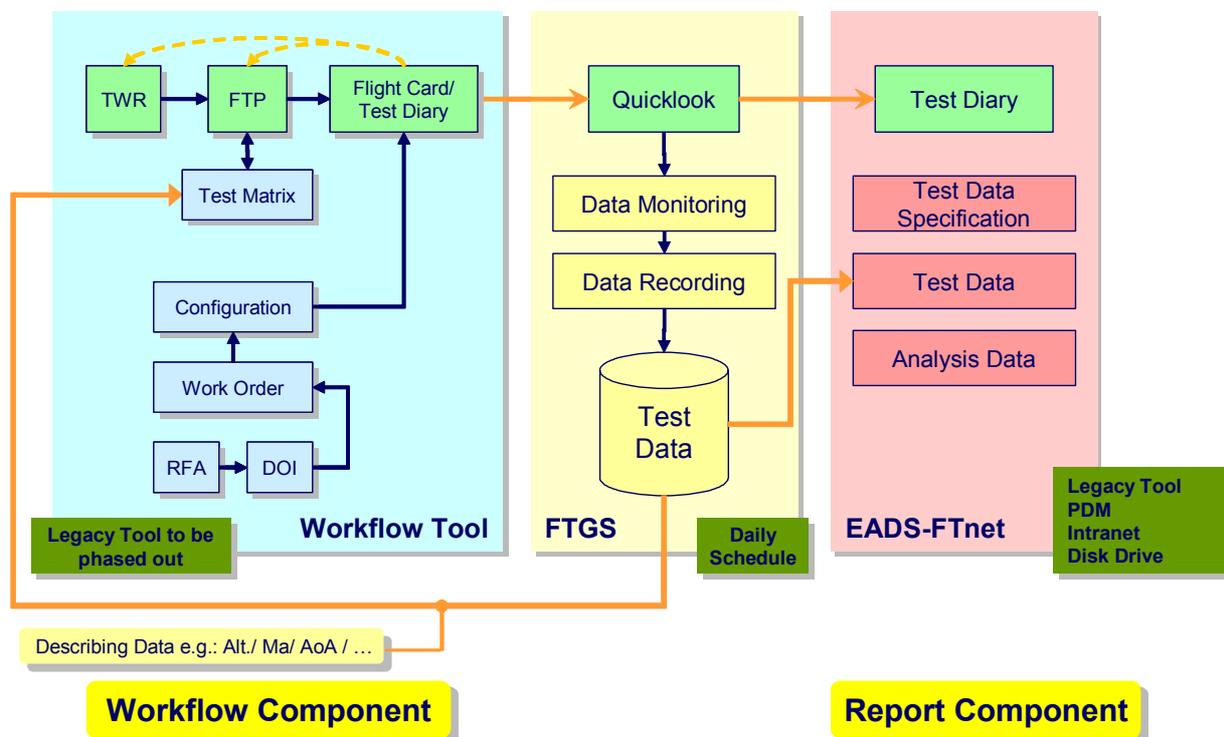
Fig. 5: Workflow Tool Integration into overall Process

The left hand part of Fig. 5 indicates the workflow tool as discussed here. It can be seen that there is still a legacy tool running which serves one legacy project. The tool will be phased out. The electronic connection from the workflow tool to the Flight Test Ground Station (FTGS) is currently being implemented. Once operative, flight cards can be supplemented electronically with specific test relevant data during the test. Also through this data channel test describing data could be send directly to the workflow tool, having them available for any desired test progress reporting. – Finally a link to the test diary is planned to enhance workflow support during the analysis process, especially serving the writing of reports. This portion of the overall process is affected by legacy tools which serve various company wide purposes. Proper interfaces need to be established.

3.3   Example Screen Shots of operative Workflow Tool

Exemplary screen shots of the operating application illustrate in the following how the workflow tool has been realised. The total application consists of far more than hundred different screens. In this paper for the sake of simplicity and restricted space only very few can be shown.
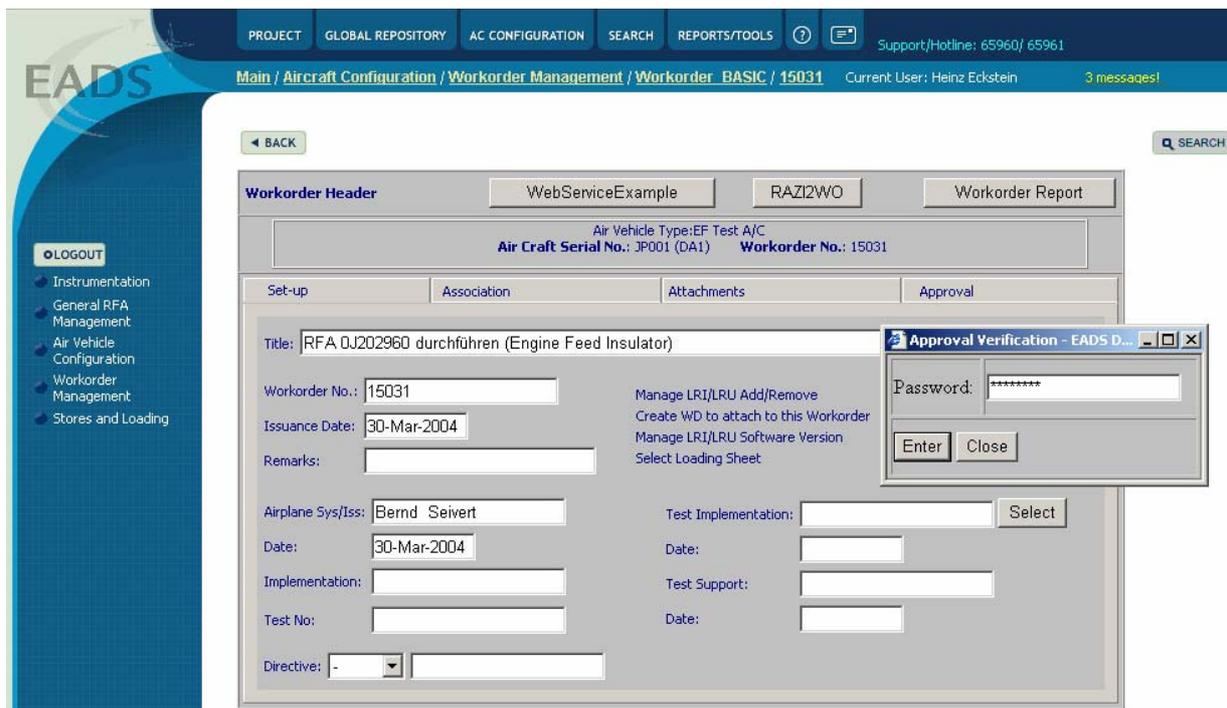
3.3.1   Work Order Management

Fig. 6: Work Order Input Screen

Fig. 6 gives a screen shot from the work order module indicating input fields for the work order header (Set-up tab). Selection of other visible tabs (Association, Attachment, and Approval) opens additional input fields for detailing of required work. Also visible is a small insert window showing the password request for an electronic signature of the work order. – According to established procedural rules a well defined number of people have to sign each work order before it becomes authorised. Each signature has to be authorised by special user password. Only if the lower level signature is set the required next level signature can be set. Once the lowest level signature is set alterations to the specific work order are not possible anymore.

Other buttons shown in this screen shot open up tutorials, connections to other tools or initiate production of the conventional paper print out. This is still being used on working level when directly executing the desired work. A respective screen shot of a paper report is given in Fig. 7. Here one can see all necessary information for all levels involved. It shows the complexity of the entire work order process. It also documents that presently paper cannot be removed entirely from process management.
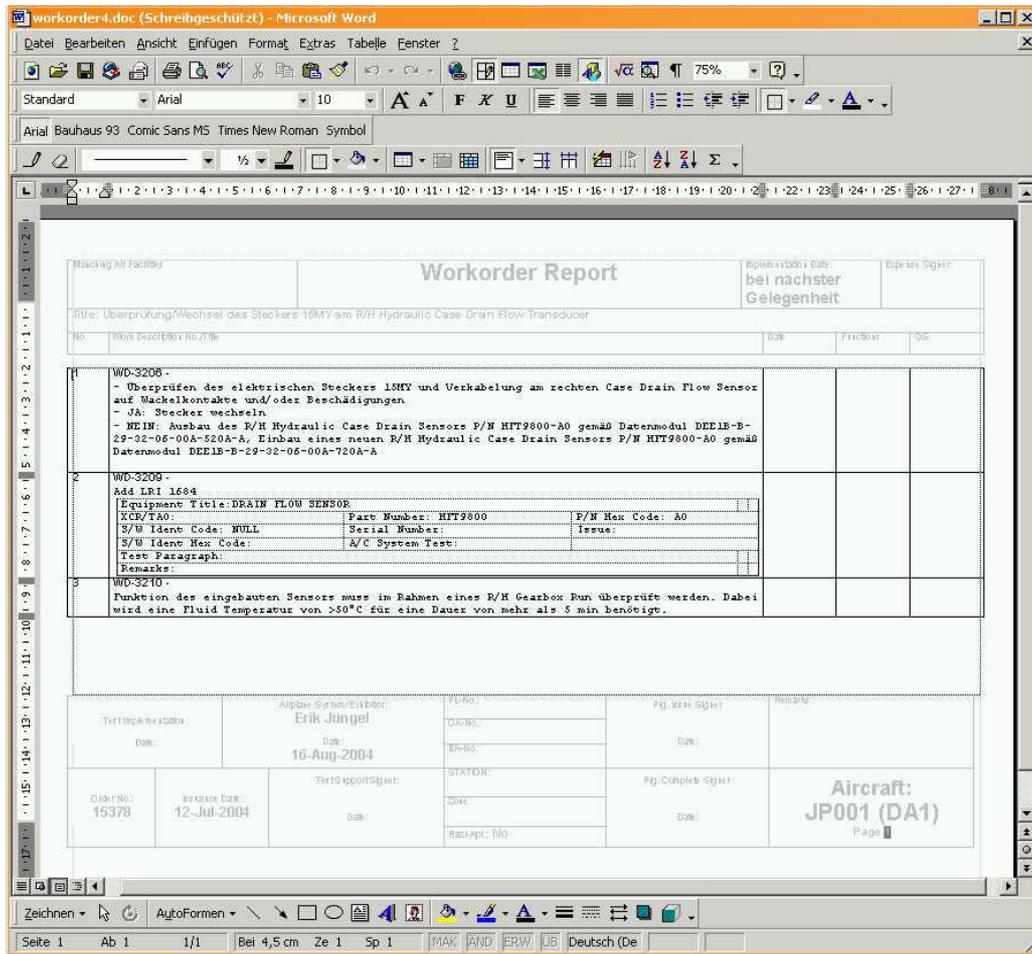
Fig. 7: Work Order Report

3.3.2 Flight Test Programme Set-up

The following Figs. 8 and 9 show two typical examples from the TWR/ FTP module. At first Fig. 8 gives an overview about the project structure. Folder type markings indicate a project with all its sub-projects. Opening a folder via mouse click reveals the sub-ordinate TWR structure whereas each TWR is designated by a hammer symbol. Opening a hammer symbol reveals sub-ordinate FTPs. Together with the FTP indication also the release status is given. A double click on a FTP entry opens the corresponding FTP.

A typical example for the FTP screen is given in Fig. 9 showing the report structure. For the set-up of FTPs a procedural rule is issued within the flight test organisation requesting all FTP authors to follow a prescribed route. This structure is also implemented in the workflow tool. The right half of the screen shot shows the "pool" of available headlines for the FTP. Clicking them and transporting them from the right to the left via "Drag and Drop Functionality" generates for a special FTP the required standardised structure. – Whereas on the right side headlines are "only" presented in a seemingly un-orderly manner on the left side the prescribed structure of the procedural rule is generated automatically. – Clicking on any entry on the left side opens the corresponding text input window.

Shown further tabs indicate other necessary input screens, including a signature screen as discussed for the work order already above. – For the sake of simplicity and restricted space explanations are omitted here.
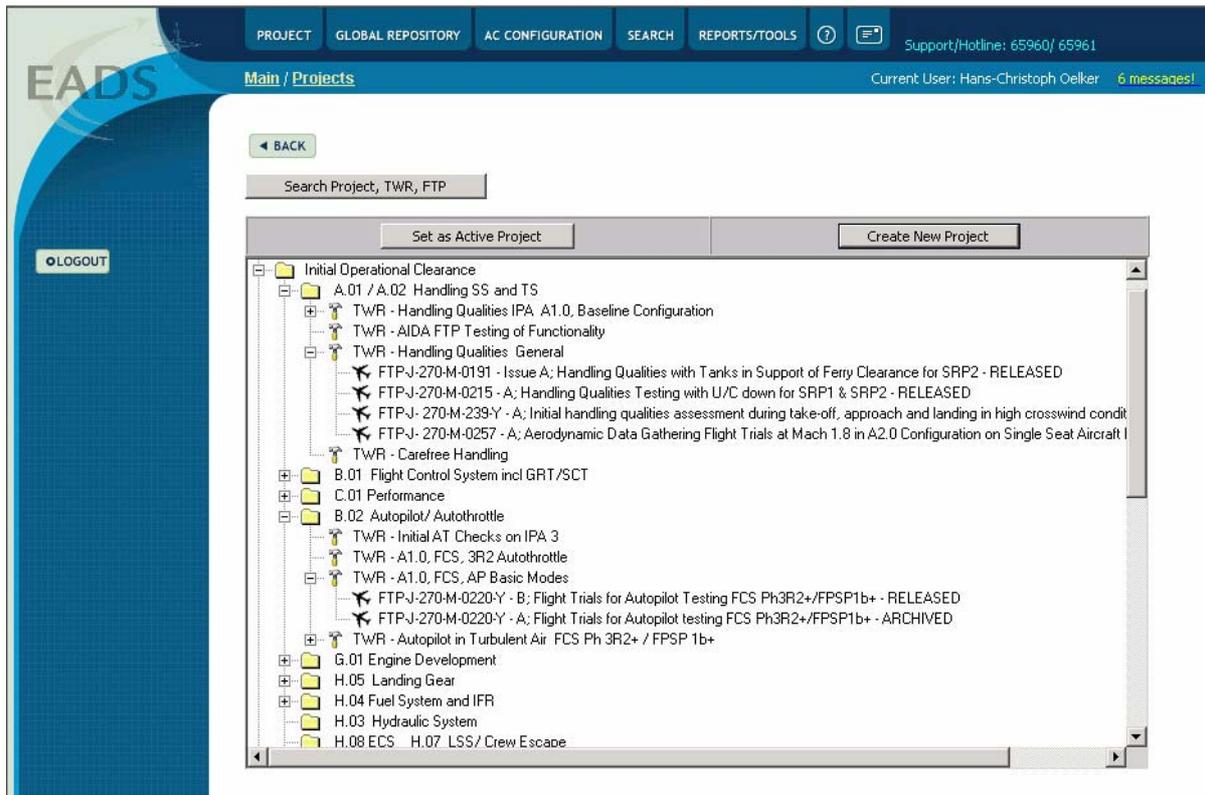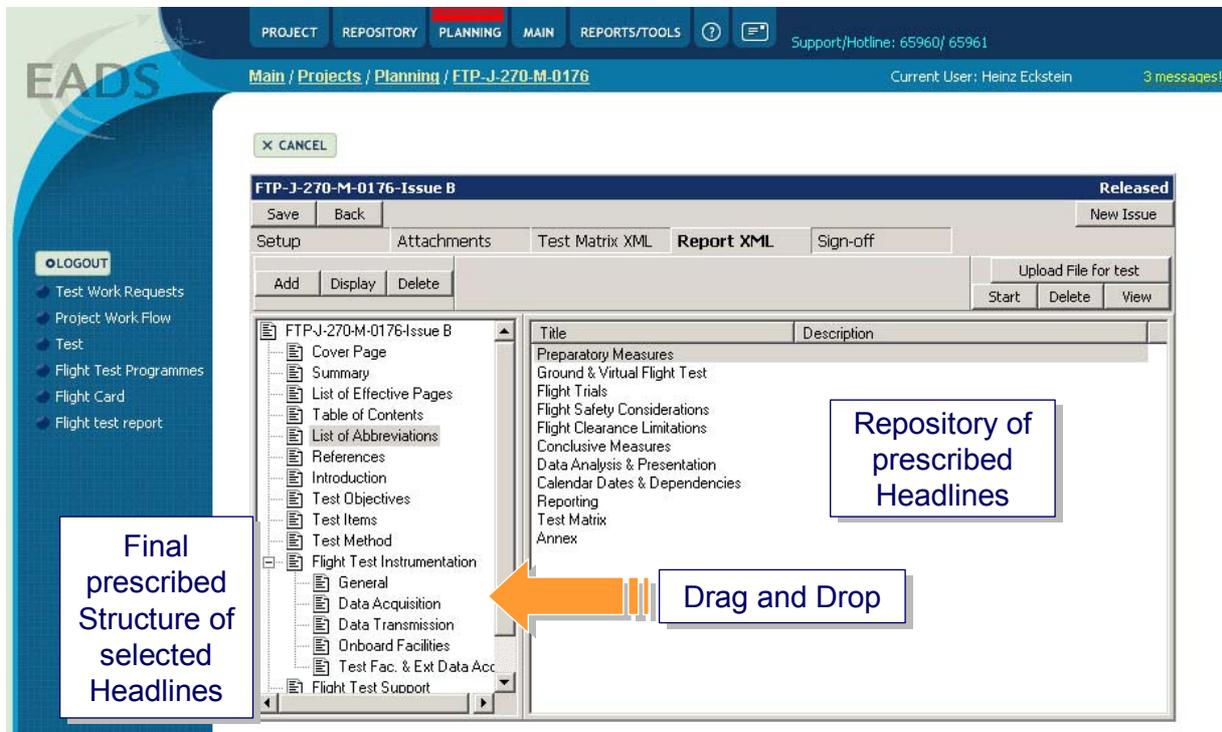
Fig. 8: Flight Test Programme Overview

Fig. 9: Flight Test Programme Report

4   EXPERIENCES

As implementation of such a highly sophisticated workflow tool is a very demanding change management process a variety of experiences have cumulated over the time. Those considered to be worthwhile have been summarised for this paper in three categories.

4.1   Project Working Experiences

Experiences within the first part of the project while the analysis with student diploma thesis was ongoing are generally very positive. As indicated already above the student team was a highly motivated team and pushing the given targets within their possibilities. From a customer's point of view the given report contained a valuable set of unbiased results. This could be achieved only through provision of a fruitful working environment. It allowed the customer who was also the diploma thesis co-advisor to keep internal guidance as low as possible. Under these circumstances the student project was considered a successful project as such.

Experience with external consultant firms was manifold. A clear benefit can be taken from their wide range of experience. Nevertheless, co-operation with such a firm always bears a risk as well, especially, when the inability of the first partner to fulfil the contract surfaced. Technological, personnel, and financial problems were the cause for this non-favourable situation which put the entire project at the rim of failure. Fortunately during this failure process contacts to a new reliable and competent partner could be established which allowed a recovery. This partner finished the project and is still involved in maintaining and expanding the workflow tool today. Nevertheless, due to these experiences EADS-M is working on being independent from external partners. Corresponding personnel measures have been taken.

These occurrences surely had an impact on time schedules. Totally on the contrary to the performance of the student team which was always on time (internal responsibility and control), now severe time delays occurred. In consequence the original specification process needed to be re-scheduled. Fulfilment of the revised time schedule with the new partner was satisfactory.

Cost was affected as well since any time overrun is equivalent to a cost overrun. Nevertheless, one positive outcome of this situation was capitalised. All software rights including source code of the tool are with EADS-M now. This was achieved through contract re-arrangement when the new partner came into the project and necessary technology development had to be supported. Thus, there are no license fees to be paid anymore. – Furthermore the availability of source code enables EADS-M to maintain the tool on its own.

4.2   Implementation Experiences

Implementation of the workflow tool project is a highly sophisticated change management task requiring appropriate management attention and commitment on all levels over the entire duration of the project. Main requirement is top down steering from top level flight test management. During the course of the project two top level management changes at Flight Test have occurred disrupting management attention to the project and causing non-favourable influences. Thus a clearly defined change route was not always given and commitment of levels involved disrupted.

Another important issue during such a project is appropriate resource management. Especially in a highly sophisticated flight test environment a thorough evaluation of a trade-off between number of directly involved personnel vs. required time and resulting cost has to be done in the beginning. Sometimes this is not possible and flexibility during the course of the project is required accordingly. Again for flight test, a clearly defined project priority level is required since flying and gaining test evidence has always the highest priority to personnel. Timely secondment of personnel to the change management project must be considered.

Specification of tool functionality was achieved through continuous involvement of the prospective user community. This process was organised in accordance with the existing department structure. It provided a steady flow of information about current project status. – Specification inputs from the user community to one certain topic could be different depending on the person giving the contribution. This required additional harmonisation effort from the project team.

Live switching of singular modules of the new software during a "running" operation was a special challenge since adverse effects on this operation must not occur. Therefore, transformation of small process steps onto the new tool has proven to be the best way of implementation. It was preceded by extensive off-line testing by affected process participants on an isolated test environment. Still, the real problems only occurred during real operation. Continuous attention by competent software specialists is the best way to alleviate these problems very efficiently.

A special point of interest to be highlighted here is the transfer of routine work from known desktop tools (MSOffice) to database oriented tools. This must not be underestimated at any instance since it affects the single user's personal comfort box. This transformation process can never pay attention to all possibly involved functionality from the originating office tool. One cannot redo this application in a data base environment. For this reason more and more of the existing tool will have original MSOffice features directly available which is possible to technology developments within the scope of this project.

Finally, a flexible software structure supports continuous software adjustments and maintenance. This has been achieved through the valuable competency of the second partner involved. The final goal though is to be independent entirely.

4.3   Process Experience

The introduction of the workflow tool within the flight test process has experienced different challenges. Generally, the transformation of legacy projects has shown various difficulties. This is mainly due to the intended change of torn in pathways which is difficult to achieve. An evaluation of trade-off between introduction and not-introduction has to be done. At EADS-M Flight Test one large legacy project has not been transformed to the new tool because this trade-off evaluation turned out to be negative. Another large legacy project though has been transformed to the new tool with entirely all processes successfully and affected process steps are managed easier now.

Through continuous application of the new tool benefits are now recognised by critical personnel as well. This process was supported by effectively functioning sub-processes, e.g. the work order procedure. During this assimilation of old behaviours to the new tool better process transparency was a valuable effect. Through this mechanism deficiencies in processes could be identified, thus, enhancing efficiency. One example is the trade-off between discrepancies between the agreed "tool process" and "practised process" behaviour which required rectifying management decisions. The question was to either change the tool implementation or to change the process. These hurdles hampered the implementation process of the tool but led to a better understanding and realisation of tool functionality and process efficiency.

Another large area for the tool implementation process was the interaction with "outside own organisation" process participants. It was sometimes a very difficult endeavour to integrate these participants into the new process. It required a lot of convincing arguments since their hierarchical reporting line is different from the flight test reporting line.

Overall process experience is positive. Process enhancements are clearly visible, so that new projects will be run with this workflow tool only in order to utilise best benefit out of it. Within the current status of the workflow tool the configuration management and planning process has been accepted best. The planned incorporation of original MSOffice functionality into the tool, as discussed above, is expected to bring further enhancements for the flight test programme and flight card modules.

Finally, as discussed in the very beginning of this paper, transparency of process know-how will make past experiences easily accessible for future projects. It will only be achieved through continuous utilisation of the workflow tool, thus, continuously storing facts and experience. – Once the tool has been "filled" with actual project data over a certain period of time the overall benefit will be clearly visible.

5   SUMMARY AND OUTLOOK

The challenges of changing markets have an impact on a flight test organisation typically orientated at military aircraft as well. To cope with these challenges at EADS Military Aircraft Flight Test a project was initiated to use modern information technology tools in support of process enhancements and refinements. Special requirements to the tool infrastructure have to be observed (flexibility for different projects, availability at different sites, retaining of procedural workflows in order not to compromise flight safety at any time). The complexity of this overall process scene justified an external analysis in order to arrive at an unbiased view of the organisation and all included processes. In the present paper an overview about resulting workflow enhancement activities at EADS Military Aircraft Flight Test Centre is given.

A team of four students from four nations within the ECATA Junior Programme (European Council on Advanced Training in Aeronautics) was installed for the first step analysis task. Their work was restricted to the engineering process of flight test (test technology and data analysis). This was considered to be a well defined task within the given time frame of six months. Requested work steps were establishment of a process map and documentation of interfaces to identify current process status, execution of an opinion survey within the engineering department to identify needs for a more effective management of information, and to establish a concept for a Data and Information Management System (DIMS) based on the findings of the survey.

The results from the students' survey showed that existing differing engineering projects (e.g. large development programmes) pursue the same processes with only minor differences on the lowest level. Therefore, a singular DIMS with necessary flexibility and compatibility for different interface processes was considered to be feasible. Involved employees were mostly open to changes in data and information management tools and identification and a clear indication of benefits was considered to support the following change process.

The second step analysis with an external consultant firm for the entire flight test process led to additional results. These were explicit identification of improvement potential for organisational sub-units and consequently the delivery of "as is" and optimised process charts. Finally the proposal for a centralised information exchange (workflow tool) in order to harmonise processes and interfaces was given. – In evaluation of all analysis results the organisational structure was streamlined and the decision for introduction of a workflow tool was made.

Main requirements for the anticipated workflow tool were "unlimited" availability to serve all process interfaces. For the user interface requirements were developed which were aimed at keeping distributed special software (client-server solution) as low as possible. This led to the concept of realising the entire user interface with WEB technology via browser technology. Thus, the only software requirement on any workstation to connect to the new system would be a sufficient network connection and a WEB browser.

The resulting tool was designed to cover the flight test backbone process from issue of a Flight Test Task over the consecutive generation of a Flight Test Programme to finally the set-up of a Test Card for execution of an individual test flight. – Coverage of the Test Task part at the very beginning of the process was designed as such that there is flexibility to cope with any presently thinkable programme structure. A resulting Test Task can cover several Flight Test Programmes, whereas a Flight Test Programme is capable to cover several test matrices as well. – A vital installed supporting process to arrive at a Test

Card with a test aircraft with a required configuration is configuration control. The workflow tool covers this process via electronically available work orders which cover the execution of an arbitrary change of aircraft configuration. Acknowledgement of finalisation of a work order task electronically leads to an update of the specific aircraft configuration table within the tool automatically. Thus, providing track on configuration requirements very efficiently.

Working experiences with the student team were very good. It was a highly motivated team. Results were considered to be unbiased and a valuable contribution for further analysis with an external consulting firm. On the contrary experience with the external consulting was twofold. During the project a change of consulting firm and selection of a new partner was necessary. The new partner supported progress and success of the project very reliably and competent in IT technology issues. Nevertheless, the company's goal is, with regard to the workflow tool, to be independent from external partners for the future.

Introduction of the workflow tool is a highly sophisticated change management task requiring appropriate management attention and commitment over the entire duration of the project (top down steering from top level flight test management, management continuity). A thorough evaluation of a trade-off between numbers of directly involved personnel vs. required time turned out to be very important. Required personnel flexibility sometimes is not possible due to daily flying tasks.

Specification of tool functionality in co-operation with the prospective user community is as vital as involvement of respective line hierarchy members. – Live switching of new software in a "running" operation is a special challenge since adverse effects on this operation must not occur. Therefore, extensive off-line testing by affected process participants on an isolated test environment was always done. Real problems if they arose during real operation were handled through continuous attention by competent software specialists. Finally, a flexible software structure supports continuous software adjustments and maintenance. This has been achieved through the valuable competency of the second partner involved.

Through continuous application of the new tool benefits are now recognised by critical personnel as well. This process was supported by effectively functioning sub-processes. During this assimilation of old behaviours to the new tool better process transparency was a valuable effect. Consequent application of the tool in some cases revealed discrepancies between the specified tool and lived processes. These could only be rectified by management action, but, revealing the value of the tool with regard to process streamlining and enhancement. Interaction with "outside own organisation" process participants was sometimes very difficult. Integration of these participants into the new process required a lot of convincing arguments since their hierarchical reporting line is different from the flight test reporting line.

Overall process experience is positive. Process enhancements are clearly visible. Transparency of process know-how will make past experiences easily accessible for future projects. It will only be achieved through continuous utilisation of the workflow tool, thus, continuously storing of facts and experience. – Once the tool has been "filled" with actual project data over a certain period of time the overall benefit will be clearly visible.

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