

DEVELOPING USE-CASES IN A GROUP

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Abstract

The Battelle Arlington Federal Civilian Operations team developed a collaborative, electronic approach for Use-Case analysis that is innovative, customizable, and efficient. The team used meeting room software as the vehicle for collecting all the data for the requirements for a information system life cycle processes for the United States Coast Guard and for the Food and Drug Administration (FDA) Tobacco Oversight Program. The basic work done in Use-Case workshops formed the foundation for the fast turnaround of requirements into the system design and speeded up the process for implementation, which is currently underway. The process was fully documented, is easy to use, and is repeatable. Adaptations to the methodology have already been undertaken and have shown that it can be easily modified to specific needs.

1. Introduction

Statement of the Problem

U.S. Coast Guard (USCG) – Mission Oriented Information System Engineering Support (MOISE)

The focus of MOISE is to develop and integrate USCG information systems (ISs) based on open

system concepts and to transition existing USCG systems to such architecture. MOISE would be composed of ISs to support marine safety and law enforcement activities, record activities and resource usage, analyze mission performance, monitor program effectiveness, monitor resource usage, exchange information between USCG offices and other agencies, and fulfill specific statutory requirements. Further, these ISs would provide local and centralized data bases, information transfer between applications and with external systems, responsive support to operational level decision makers in the maritime law enforcement environment, up-to-date information for boarding and patrols, strategic planning, management of personnel, facility and budget resources, assessment of USCG mission effectiveness, distributed data and distributed processing to increase availability of information, enhanced portability, information security, and standardized user interface. The users of the Iss developed in MOISE would be USCG personnel at their headquarters in Washington, DC, the USCG Operations Systems Center, and USCG field installations worldwide.

Food and Drug Agency (FDA) – Tobacco Program

The FDA problem definition originated upon a two-year investigation of the tobacco industry

from 1994-1996, the FDA asserted regulatory authority over cigarettes and smokeless tobacco products through a rule issued in 1996 designating regulations related to the advertisement and sale of these tobacco products. Subsequently, an implementation model was developed that led to the development of contracts with the States to become partners in enforcement of the rule. The Tobacco Program was funded for the 1997 fiscal year to conduct an enforcement pilot study in various States. The success of the pilot program led to increase funding for fiscal year 1998 allowing the program to expand to the remaining States.

The Tobacco Program consisted of several major areas of concentration including State Contracting, Outreach, Enforcement, and Civil Money Penalties. Additional activities such as research and evaluation were conducted in support of the program. An Associate Commissioner managed these functions, with support from other Associate Commissioners and Advisors. The software development project for the Tobacco Program stopped in March 2000 after the Supreme Court ruled that FDA couldn't regulate tobacco products until given authority by Congress.

The FDA Tobacco Program enforced those rulings of the FDA regulations dated February 28, 1997, concerning minors' use of and accessibility to nicotine-containing cigarettes and smokeless tobacco products. In this regard, the Tobacco Program was responsible to develop partnerships with State and local officials to enforce certain provisions of the regulation and to increase tobacco retailer awareness and compliance with the regulation. The overall goal of the FDA tobacco effort was to reduce young people's use of tobacco by 50% within 7 years after the rule is fully in effect.

As the program matured, it was envisioned that the mission would be supported by a comprehensive automated system. This system should provide easy access to program related data by all Tobacco Program staff members, as needed. The system would also provide the tools required to efficiently and effectively contract with the States, perform outreach, track compliance activities, manage the civil money penalty process, and conduct research and evaluation related to the program.

The Food and Drug Administration (FDA) Tobacco Oversight Program System (TOPS) development started in July 1998 in response to the need to automate program functions. The Tobacco Program's success depended on the ability to perform the following: compliance checks, retail lists maintenance, civil money penalties, state contracts, outreach, provide hotline and web access, and statistical reporting.

Key elements and required functions of the TOPS system (as of September 1999) were the following:

- Initiate and maintain a database of retailer compliance history
- Initiate State contracts and monitor activity
- Establish and maintain an Electronic Case File for CMP cases
- Publish data and descriptive information to an Internet web page:
 - To States
 - To Public
- Integrate with other FDA MIS systems
 - Dockets
 - Contracts
 - Financial management for CMP payments
 - Standards Compliance
 - Security and access control
 - Comply with FDA's Information Systems Architecture (ISA)

- Privacy/FOIA

TOPS was being deployed in increments. As of September 1999, TOPS had three increments ready for implementation. By January 2000, training had begun for implementation of Increment 1. The increments were defined based on Tobacco Program Office (TPO) business priorities and technology.

2. Battelle Approach

During the development of the TOPS System Concept in 1998, Battelle established a set of objectives and principles for design. These objectives were based on the emerging business needs for the Tobacco Program. The Tobacco Program was new and its business processes were evolving. It was expected that the Program might have requirements that were as yet undefined or incomplete.

The Battelle methodology for identifying requirements for TOPS and MOISE was based on the application of technology in software engineering and knowledge management. The primary product was a set of Use-Cases to identify the functional requirements for the systems (TOPS/MOISE). The content of the Use-Cases was obtained and validated with the assistance of electronic meeting software, which captured and organized the required functional knowledge. The output of the meeting software was analyzed and incorporated into a revised set of Use-Cases that represents the system requirements.

3. Background

Object-Oriented Analysis

In software development the software process is typically based on the so-called "waterfall" model. This model dictates that all requirements analysis be completed before

doing any design, all design be completed before doing any implementation, that all implementation be completed before doing any testing, and that all testing be completed before release.

An incremental/iterative process can be a much lower-risk approach to system analysis and design. It can be lower risk by identifying core subsets of the product designed, implemented, and tested early. With the core product designed with end-user feedback, such a process results in a product that is much more effective at satisfying the end users real requirements. Using object-oriented technology developed by Grady Booch, Ivar Jacobson, and James Rumbaugh, this type of approach can provide significant savings in development time and avoidance of errors.

Use-Case Approach

Ivar Jacobson published a book in 1992 about using Use-Cases in object oriented software engineering.^[1] For a long time developers struggled with the information needed for the modeling of a proposed system. Creating a requirements document was a necessary step, but no formal provisions guided what this type of document should look like. In this area, the impact of Ivar Jacobson's work with Use-Cases has been significant. His contribution was that he made Use-Cases the central notion of the development process.

Jacobson defines a Use-Case as when a user performs "a behaviorally related sequence of transactions in a dialogue with the system." The art is to identify the users' goals, not the system functions. One way of doing this is to treat a user's business task as a Use-Case, and to ask how the information system can support it.

^[1] I. Jacobson, M. Christerson, P. Jonsson, G. Overgaard, "Object-Oriented Software Engineering – A Use-Case Driven Approach", Addison Wesley Longman Ltd, 1992

Use-Cases have been adopted within the software engineering discipline because they present an effective tool in communicating to users and developers. From a developer's perspective Use-Cases are simple to model, from a user's perspective Use-Cases are simple to understand. Use-Cases is presently used during many stages of software development.

- To capture requirements.
- To act as a spring board for software design.
- To validate the software design.
- For software testing and quality assurance.
- Potentially as an initial framework for the online help and user manual.

Use-case diagrams provide a way of describing the system interactions with the processes involved in performing the business of the organization. The representation that is used is the naming of actors. Actors are roles played by various people, or other computer systems. The emphasis on roles is important: one person may play many roles, and a role may have many people playing it. Use-cases are actually interactions that the actor has with the system. A Use-Case is a structured description of the interaction between a user and the system. It depicts the entire sequence of a user's interaction with a system to perform a required business function.

Difficulties occur for a variety of reasons in creating good use-cases. One team who published their results developed a theory about how to use these Use-Cases in 1994 (Journal of Object-Oriented Programming, in two parts, the Sep-Oct 1997 issue and the Nov-Dec 1997 issue.) This team used Use-Cases, navigated around them, and used non-specialized tools on them. They found that users could understand the Use-Cases. All the Use-Cases were as part

of the contract requirements and reviewed for project completion. The structure was used to estimate, staff, track and manage the project. The team said it was an improvement over how they had been working before and would use it again. In other words, the theory worked in this case.

Specific Needs of the Customer

The FDA Tobacco Program staff knew the need to identify functional requirements with their help was an critical success factor in getting a information system built within any reasonable amount of time. Their concern was their level of individual involvement. They were reluctant to meet day after day for the contractor to capture what they were not yet doing. They were hoping to have the contractor develop an acceptable and efficient process quickly.

Speed of development, accuracy of captured data, and continuous process improvement were topmost criteria for the requirements capture portion of the new information system.

The USCG MOISE project realized that due to the broad nature of the ISs they intended to implement, a need for efficient overall system planning, development, and integration was required. The USCG anticipated that the MOISE systems would address all system components including hardware, commercial-of-the-shelf (COTS) software, telecommunications, and non-automated components. They also recognized that there was a need for business process reengineering to address the need to perform more missions in more widely scattered areas while experiencing a reduction in force. A situation experienced by many government agencies.

4. Methodology

Use-Cases

The Battelle team decided to employ Use-Cases to identify TOPS functional requirements. Likewise, Battelle project team for MOISE identified that the application of Use-Cases would be beneficial in modeling the existing business processes and to identify improvement opportunities to be applied to the could-be model for MOISE systems.

Many developers have tried to replicate Jacobson's methods. Classes are taught about Use-Cases, the literature abounds with examples of Use-Cases, and yet the development of Use-Cases is still open for interpretation and improvement. Even other staff within Battelle had developed Use-Cases for requirements analysis in other projects. To understand the advantages and the lessons learned from their experiences, the Battelle teams for TOPS and MOISE gathered information from staff on two other development projects.

Customizing the findings to the needs of the two different clients (TOPS and MOISE) and with Battelle's goals to expedite the process, the Battelle technical staff created a structure to standardize all Use-Cases.

The Use-Cases were structured as follows:

- Name: The name of the function describes in the Use-Case
- Purpose: A One or two sentence description of the function performed in the Use-Case.
- Primary and Secondary Actors: Actors are any entities that interact with the system. These entities can be people, organizations, or other systems that either provide, or receive information from the system. The name of the Actor will typically reflect the role, rather than the name of the person.
- Primary actor: is the one from whose viewpoint all the action occurs.
- Secondary actors: are any other actors involved in the action.
- Pre-conditions: Anything that needs to have taken place or be true, before a Use-Case can start. It can be another Use-Case.
- Pre-conditions: Anything that needs to have occurred or be true, before a Use-Case can start. It can be another Use-Case.
- Variations: alternate paths of execution in the Use-Case based on certain conditions or decisions. Variations may also used to group/organize a set of sequential activities within the Use-Case.
- Flow of Events: The Flow of Events is the sequence of interactions when an Actor uses a part of the system. Events can be various activities (verbal, written, electronic). Each event contains the following:
 - Event number and description.
 - Information Items: Data that is entered, viewed, and/or updated by an event.
- Rules: "Operational norms that organizations follow in performing their activities." These are the business rules followed while executing the event.
- Post Conditions: The results of executing the Use-Case. The state of the system as changed by executing the Use-Case.

- **Terms:** Definitions of terms specific to the Use-Case.

The “initial” Use-Cases used as input to the workshops was developed in the following sequence:

The Business Process Report documented the Business Process Model for the FDA Tobacco Program and similarly, for the USCG MOISE program. The Business Process Model was analyzed to identify functions that met the criteria for development of a Use-Case. The list of functions in each process was reviewed and modified. The detailed business process functions were analyzed in accordance with the system concept and the system design objectives. This resulted in the set of Draft Use-Cases that were presented at the initial Use-Case workshops.

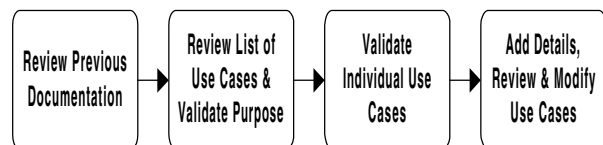
Electronic meetings

Electronic meeting software or “GroupWare” was utilized to review the Use-Cases with the subject matter experts called in from the respective organizations. Additionally, the gathering of requirements on the individual Use-Cases was performed. Electronic meetings are known to reduce time for meetings and increase commitment and achievement of groups and teams. Each participant has the use of a personal computer; and a facilitator helps the meeting participants run the meeting. Electronic meeting technology allows participants to say what they want to say anonymously; this fact creates a stimulating atmosphere and usually exceptional results. The computers are loaded with group meeting software, which allows participants to enter opinions, facts, suggestions, or votes, and are typically used for 30-50% of the meeting. The rest of the meeting is devoted to discussion and conversation. Overhead projection capability provides a central focus for group discussions and slide presentations.

Collaboration Methodology

Client staff from each process area participated in a computerized/electronic meeting wherein information was simultaneously inputted and responded to on the personal laptop computers. The information was input simultaneously so that each member was able to have an equal amount of time discussing, or typing input, on all aspects of the Use-Cases to include each component from the purpose to the post conditions. Seventeen workshops total were conducted within three months.

The following process model depicts the workshop methodology used to gather user requirements.



Use-Case workshops were held over a period of two days for each process area. Workshop participation ranged from three to fifteen staff. Within that time frame, participants were asked to focus only on the process area. Issues that were related or tangential were “parked” to be gathered and discussed at other workshops or in the final make-up workshops. A standard procedure was developed to review all related Use-Cases for each process area and was repeated for all Use-Case workshops. Using paper copies with the Use-Case entered into the GroupWare software, participants could follow the Use-Case on paper or on their personal laptop or on the projection screen.

Step 1: Review previous documentation

- Review Business Process flow diagrams developed by the FDA/USCG staff.

- Review recommended improvements and system design components. Discuss, if necessary, to reconnect rationale to recommendation.

Step 2: Review list of Use-Cases and validate purposes

- Review proposed list of Use-Cases for the process area.
- Add or modify any Use-Cases that was appropriate to the process area.
- Validate purposes of each Use-Case to insure clarity, focus, and accuracy.

Step 3: Validate individual Use-Cases

Review individual Use-Cases:

- Review and modify actors,
- Review and modify pre-conditions,
- Validate flow of events,
- Review and modify the descriptions of the events,
- Review and modify post-conditions.

Step 4: Add details, review & modify Use-Cases

- Participants began at this step to enter information on the GroupWare software. The Use-Case appeared in an outline form that matched the paper copy they were reading.
- Add details for individual events.
- Review and modify information items and rules.
- Define terms.

At the end of entering the information into the GroupWare software, participants engaged in a conversation regarding controversial issues or internal GroupWare conversations, which had appeared during the input period. The facilitator led the discussion to consensus on each disputed

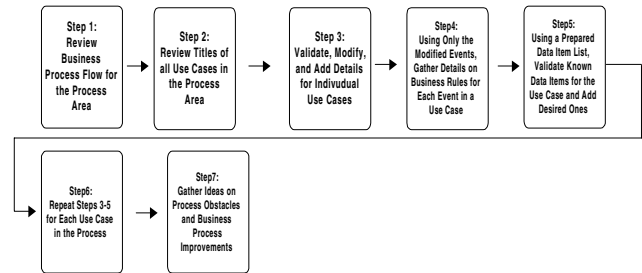
point. The technographer noted the agreement in the GroupWare software by typing AGREEMENT and the text of the agreements in capital letters. The GroupWare provided hard and soft copy reports for further analysis by the Battelle team in refining the Use-Cases.

5. Adaptation

Needs for FDA Automated Information Management System (AIMS) Methodology

FDA staff from each process area participated in such a computerized/electronic meeting wherein information was simultaneously inputted and responded to on the personal laptop computers. The information was input simultaneously so that each member was able to have an equal amount of time discussing, or typing input, on all aspects of the Use-Cases to include each component from the purpose to the post conditions. Thirteen workshops total were conducted within two months.

The following process model depicts the workshop methodology used to gather user requirements.



Use-Case workshops were held over a period of 4 days for each process area. Workshop participation ranged from 3 to 15 staff. Within that time frame, only staff members who were directly responsible for the process area worked for the first 2 days and in the second 2 days, participants who were actually “customers” of the process provided their comments. Issues that were related or tangential were “parked” to

be gathered and discussed at other workshops or off-line. A standard procedure was developed to review all related Use-Cases for each process area and was repeated for all Use-Case workshops. Using paper copies with the Use-Case entered into the GroupWare software, participants could follow the Use-Case on paper or on their personal laptop or on the projection screen.

Step 1: Review business process flow for the process area

Business Process flow diagrams developed by the Battelle staff before the sessions based on current documentation of the process. The group reviewed and discussed the flow of the Use-Cases in relation to the entire process. This review thereby validated the interconnectedness and the order of the Use-Cases in the process.

Step 2: Review titles of all Use-Cases in the process area

- Review proposed titles of Use-Cases for the process area.
- Add or modify any titles to insure clarity, focus, and accuracy.

Step 3: Validate, modify, and add details for individual Use-Case: purpose, actors, variations, and events.

- Review individual Use-Case in the following way:
- Review and modify purpose.
- Review and modify actors.
- Review and modify pre-conditions.
- Validate flow of events.
- Review and modify the descriptions of the events to include variations.
- Review and modify post-conditions.

Step 4: Using only the modified events, gather details on business rules for each event in that Use-Case.

Participants began at this step to enter information on the GroupWare software. The Use-Case events appeared in topic comment form – one topic for each event.

- Add rules about the event.

At the end of entering the information into the GroupWare software, participants engaged in a conversation regarding controversial issues or internal GroupWare conversations, which had appeared during the input period. The facilitator led the discussion to consensus on each disputed point. The technographer noted the agreement in the GroupWare software by typing AGREEMENT and the text of the agreements in capital letters. The GroupWare provided hard and soft copy reports for further analysis by the Battelle team in refining the Use-Cases.

Step 5: Using a prepared data item list, validate known data items for that Use-Case and add desired ones.

Again utilizing the GroupWare software and using a prepared data table on the paper copy at the end of each Use-Case, participants worked on modifying term definitions and validating and modifying data items for the Use-Case.

Again at the end of entering the information into the GroupWare software, participants engaged in a conversation regarding controversial issues or internal GroupWare conversations which had appeared during the input period.

Step 6: Repeat steps 3-5 for each Use-Case in the process.

Step 7: Gather ideas on process obstacles and business process improvements.

When participants are finished working on each Use-Case, a brainstorming session utilizing the GroupWare software allows each participant to offer ideas and suggestions about what is currently in the system and what enhancements would be helpful. Little or no discussion was required, as this was part of the analysis.

6. Conclusions

Accomplishments

- Battelle's customized Use-Case methodology and efficient GroupWare workshops provided the basis for client commitment to Battelle's methodology.
- Battelle developed and presented 120 Use-Cases and conducted 45 Use-Case workshops for MOISE from January 1998 to September 1999.
- Battelle developed and presented over 80 Use-Cases and conducted 30 Use-Case workshops using GroupWare technology from the period August 1998 – April 1999.
- Battelle developed and presented 45 Use-Cases and conducted 15 Use-Case workshops from May 1999 – June 1999 for AIMS.

Lessons Learned

LESSON 1: Use-Case methodology must be introduced in a simple, easy to understand process with facilitated guidance through the first Use-Case.

- Initial overview of Use-Cases and their structure was included in the initial workshops. After the initial “learning curve”, all levels of staff from clerical to executive were able to apply the acquired

knowledge of Use-Case methodology to subsequent Use-Cases with ease.

- Facilitators, technographers, and session analysts need to read and understand Use-Case methodology in order to be able to answer questions and give examples during the session.
- Preparation sessions given by facilitators and technographers who have completed Groupware sessions are extremely helpful to help new facilitators and technographers understand Use-Case methodologies from first-hand experience.

LESSON 2: Use-Case workshops need to make the most efficient use of time.

- Participants become “weary” and less productive when workshops drag on and on.
- The room used for the workshops must be comfortable, provide adjustable lighting, and environmental controls.
- Two and ½ hours in the morning and 2 ½ hours again in the afternoon kept participants refreshed and productive.
- All sessions should be custom designed to the needs of the participants and their work styles. Making the most efficient use of time should always be a guiding principle.

LESSON 3: Requirements identification and review must be done in the most efficient manner and remain flexible to adapt to the possibility of discovered differences, which occur during the workshops.

- Pre-developed Use-Cases based on actual workflow and interviews in most cases provided a sufficient basis for discussion.
- Some participants become skilled enough to help re-write the Use-Cases in the actual sessions.
- In some cases a Use-Case may not represent a business process accurately. Facilitators must be able to quickly redesign the activity

and elicit the correct components of the Use-Case from the participants and work with the attendees to create the appropriate Use-Case.

LESSON 4: Participants welcomed the use of the GroupWare technology as a critical success factor in gathering their input in a fair, unbiased, documented way.

- Customer comments continually reflected participant delight in having an open forum for their input.
- GroupWare output insures documented comments from participants on every element of the Use-Case to include rules and information items.
- Facilitators and workshop planners must listen to recommendations provided in the workshop comments collected at the close of a workshop. The planners and facilitator must evolve the workshop experience to ensure it continues to be successful.