Cabin Management System Design Based on MBSE

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Abstract. Cabin management system intended to provide an advanced, highly integrated and friendly human machine interface operational environment for the cabin crew. This article focus on cabin management system design based on MBSE to describe the process of system engineering design based on MBSE.

Keywords. MBSE, cabin management system, functional analysis, operational analysis, logical analysis

1 Introduction

During the aircraft conceptual design phase, many functions, requirements need to be pursed and system architecture options should be compared in a short time. To speed up this process, efforts have been made in the past decades to digitalize parts of the design process, and find an approach to support the digitization.[1][2]In 2007, INCOSE defined MBSE as a formal application of modeling to support system requirements, design, and other activities, And proposed the MBSE vision plan for the first time at the meeting, from 2007 to 2020,MBSE would become a mature theory from a plan.[3]Now an MBSE approach can support the aircraft design from requirements to products.

The process of MBSE based system design divided into 5 steps, which are perform operational analysis modeling, perform system analysis modeling, perform logical architecture modeling, perform physical architecture modeling and perform EPBS modeling, the last two steps are generally performed by system suppliers.[4][5]This article mainly describes the design process of cabin management system through MBSE, from operational analysis model, system analysis model to logical architecture model, which provide input of product design to system suppliers.

Cabin management system consists of multiply types of interactive peripherals, like fixed, portable and/or wearable devices that provide cabin status display and facilitate cabin crew operation.

2 Operational Analysis Model of Cabin Management System

Operational analysis model deal with the issues concerns about what users want to do. the first step of it is define the activity or the entity while operating cabin management system. The entity in operational analysis model includes users of a product and product itself, a product

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can be a system, cabin, even the whole aircraft. The users of cabin management system are cabin crew, passenger and maintenance personal. Like figure 1,it shows the definition of cabin management system's users.

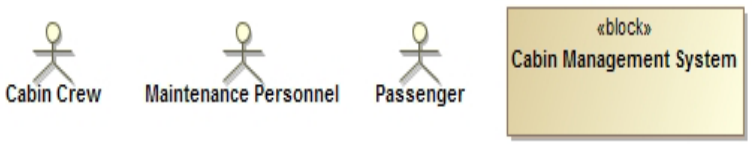

Fig.1 OEBD of Cabin Management System

And OCB shown in figure 2 describes capabilities related to the process of cabin management system operation, and the capabilities mean the functions users want this product to achieve from top level. For cabin management system, the function cabin crew wants to achieve is providing cabin environment management assistance and passenger service, passenger wants is getting service and maintenance personal wants is providing cabin maintenance before/after a flight.

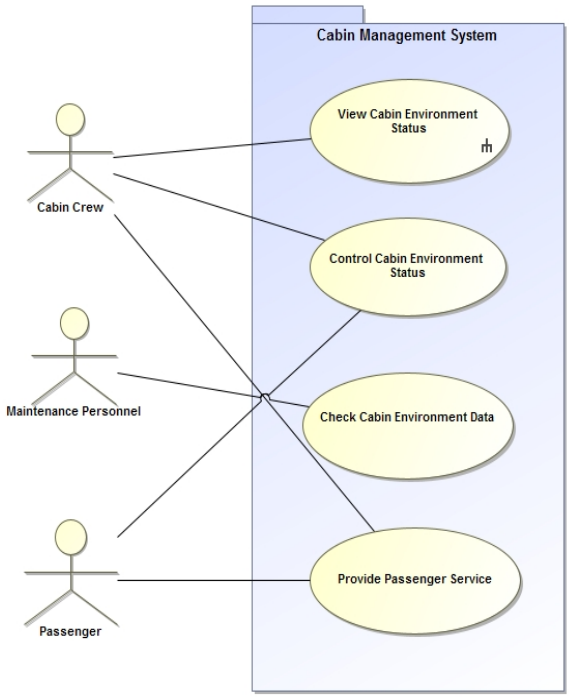

Fig.2 OCB of Cabin Management System

OES need scenario building to capture the need of users' operation fully, which define the activities in operation. If the capabilities of entity is goal of top level, the activities would be decomposed operation to achieve goal. figure 3 shows the typical operation scenario of cabin environment management.

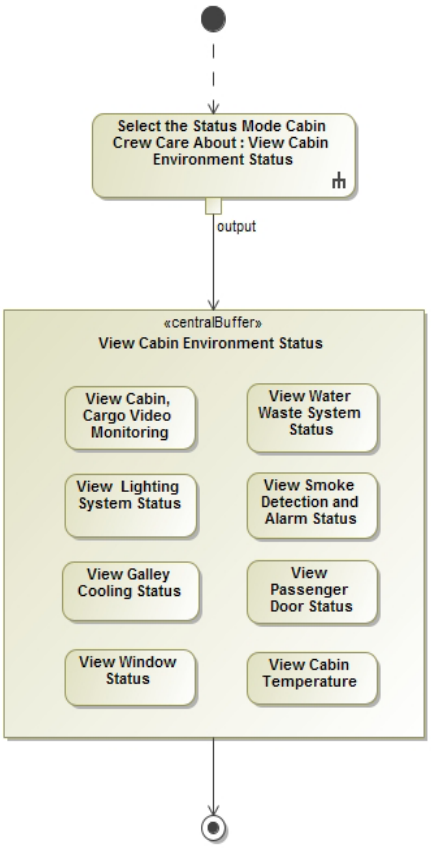

Fig.3 OES of Cabin Environment Management

3 Cabin Management System Functional Analysis

Cabin management system functional analysis is based on operational capabilities and operational activities analysis to define system function. According to the engineering experience, achieve the function extended from operational analysis can be corresponded to the system function in system develop process, and carry out functional analysis like figure4.

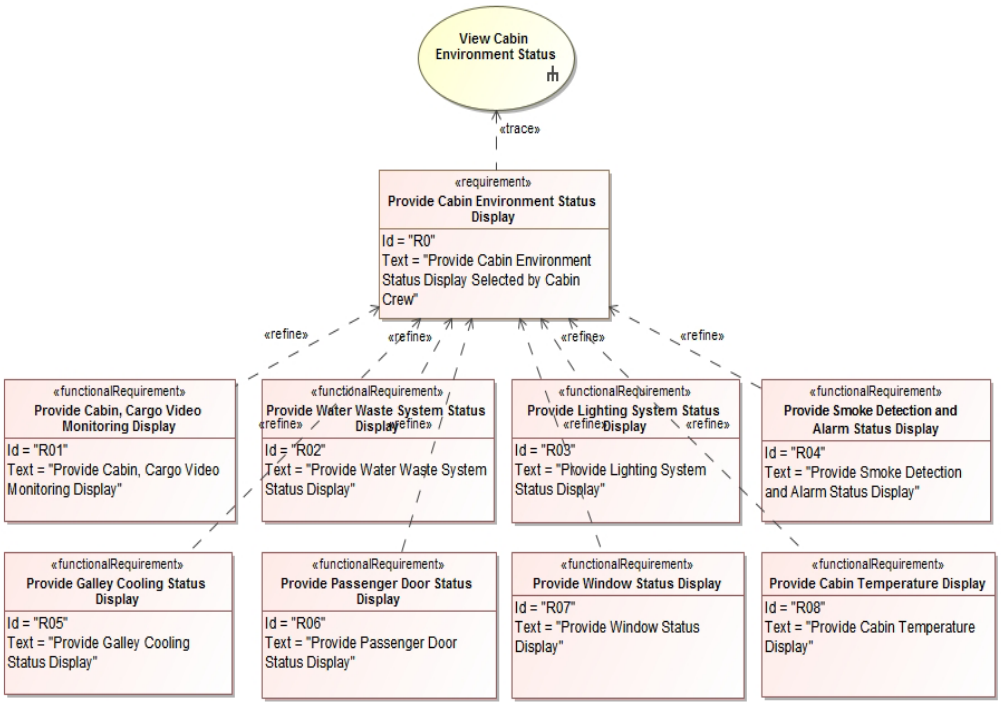

Fig.4 Cabin Management System Function Break Down

Additionally, the functional analysis of cabin management system. Includes defining functional scenario, functional scenario analysis is determined to help designer restore the application scene preferably, specific system functional requirements. Figure 5 shows the scene of cabin crew check cabin status, like view the cabin monitor, view the water/waste system status, view door status and cabin light system status.

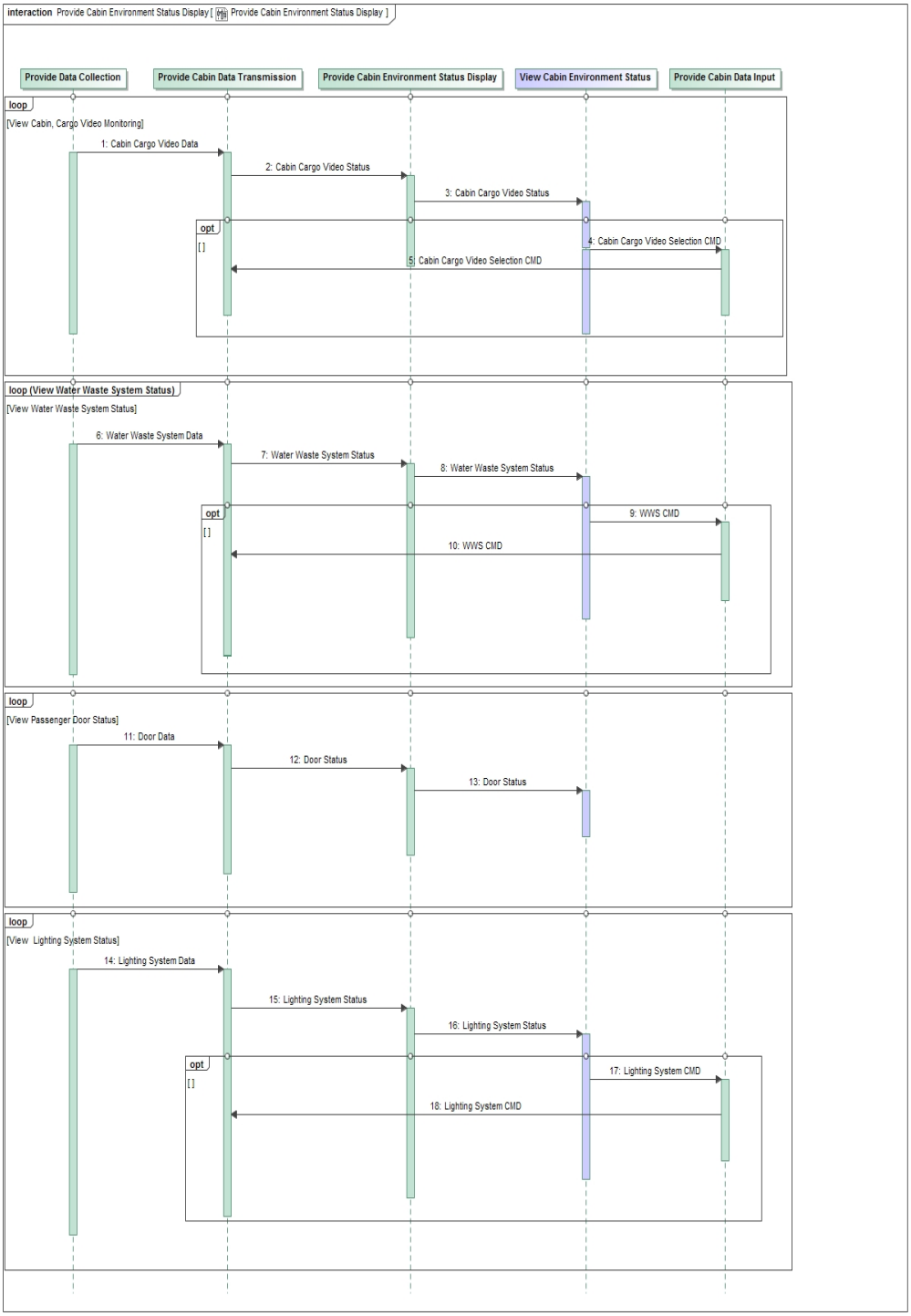

Fig.5 ES of Provide Cabin Environment Status Display

4 Logical Architecture Model of Cabin Management System

Logical architecture modeling of cabin management system is the third step of system engineering design based on MBSE. In this phase, detail system composition, interface and data flow between systems and function allocation can be got through logical analysis. Generally, logical analysis can achieve equipment analysis level, the first phase of logical architecture is extended from system functional analysis, the next is perfect logical level function which describe the functional interaction among logical module and make improvement during analysis. Like figure 6,logical level analysis of cabin management system, process decomposition of logical module, which are headed equipment like cabin controller; network node like cabin data distribution unit; terminal equipment like cabin management terminal and external equipment, such as system connected to avionics core process system. And then allocate function to logical module, this phase will define the function and data flows of every logical module, finally get a system logical architecture.

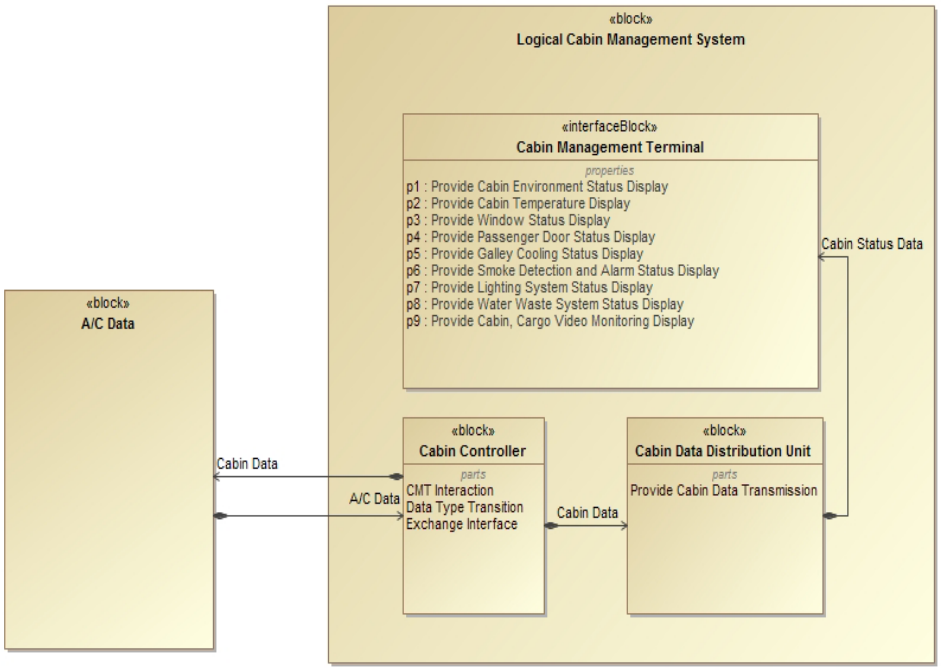

Fig.6 LAB of Cabin Management System

5 Conclusion

With the analysis process mentioned before, finally get the input of cabin management system design based on MBSE as below which we can provide to system suppliers to achieve the system physical architecture:

(1) Cabin management system shall contain equipment that provide cabin data storage, processing, distribution, indication and control.

(2) Cabin management system shall provide interfaces to receive signals like door status signal, cabin lighting status signal, water/waste system status signal and cabin monitor video signal.

(3) Cabin management system shall provide interfaces to send signals like cabin lighting command signal, water system pre-selected command signal and cabin monitor selected command signal.

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