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A Brief Discussion on Work Breakdown Structure

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ABSTRACT:

A crucial tool in system engineering, the Work Breakdown Structure (WBS) acts as a hierarchical representation of the project's deliverables and activities. It offers a methodical way to break down large systems into manageable, clearly defined parts, supporting efficient project planning, execution, and management. The main advantages and uses of WBS are highlighted in this abstract, which also examines their relevance in system engineering. Along with highlighting the significance of stakeholder interaction and ongoing improvement throughout the project lifetime, it also covers the fundamental procedures required in developing a WBS. The abstract also discusses the function of WBS in aiding resource allocation, schedule planning, risk management, and team member communication. System engineers may increase project success rates, foster cooperation, and optimise resource allocation by properly using the WBS approach. This will eventually result in the construction of high-quality systems within predetermined restrictions.

KEYWORDS:

Breakdown Structure, Schedule Planning, WBS Flow, WBS Physiology.

I. INTRODUCTION

To organise and specify the scope of work necessary to accomplish a project, project managers utilise the Work Breakdown Structure (WBS). The project's deliverables, activities, and tasks are broken out hierarchically, allowing for more efficient planning, scheduling, and resource allocation. Project managers and team members can better comprehend the project's structure and needs thanks to the WBS, which divides the project into smaller, manageable components. It gives stakeholders a clear grasp of the work necessary and the relationships between various aspects by visualising the project's scope. In most cases, project managers, subject matter experts, and team members work together to build the WBS. It begins with determining the main outputs or deliverables of the project, which are then broken down into smaller, easier-to-manage work packages. Every work package is then broken down into certain activities and tasks to ensure a thorough description of the work needed [1], [2].

The WBS assists in defining the project's goals, identifying the required resources, estimating the project's time and cost, and allocating duties to team members by breaking the project down into smaller components. It offers a strong framework for project planning, scheduling, and management. The WBS also provides a framework for coordinating and communicating about projects. Stakeholders can quickly monitor progress, spot possible bottlenecks, and keep tabs on the fulfilment of certain tasks and work packages thanks to this. It helps team members to work effectively together and to clearly communicate project objectives and needs. A reference for risk management, quality assurance, and change management may also be found in the WBS. It assists in identifying possible risks and the corresponding mitigation plans, ensuring that quality standards are followed at every stage of the work breakdown structure, and determining the effects of modifications on the project's scope and timeline [3], [4].

The Work Description Structure (WBS), which offers a hierarchical description of the project's deliverables, activities, and tasks, is, in essence, a useful tool in project management. It facilitates efficient resource allocation, planning, and scheduling, improves project collaboration and communication, and acts as a guide for risk management and quality assurance. The WBS is essential for planning and outlining the scope of work necessary to finish a project [5], [6].

II. DISCUSSION

System development activities may be organised using the Work Breakdown Structure (WBS), which is based on system and product decompositions. System and product descriptions are created using the systems engineering methodology discussed in prior chapters. These product architectures are organised and represented in a hierarchical tree-like structure known as the WBS, together with any accompanying services (such as programme management, systems engineering, etc.).

In Figure 1, The WBS might be regarded as an output of the systems engineering process since it is a direct descendant of the physical and systems architectures. Due to its fundamental applicability for every step of the systems engineering process, it is being offered here as a tool for systems analysis and control. It is used for non-technical programme management tasks including organising integrated teams, locating data and documents, and structuring development activities.

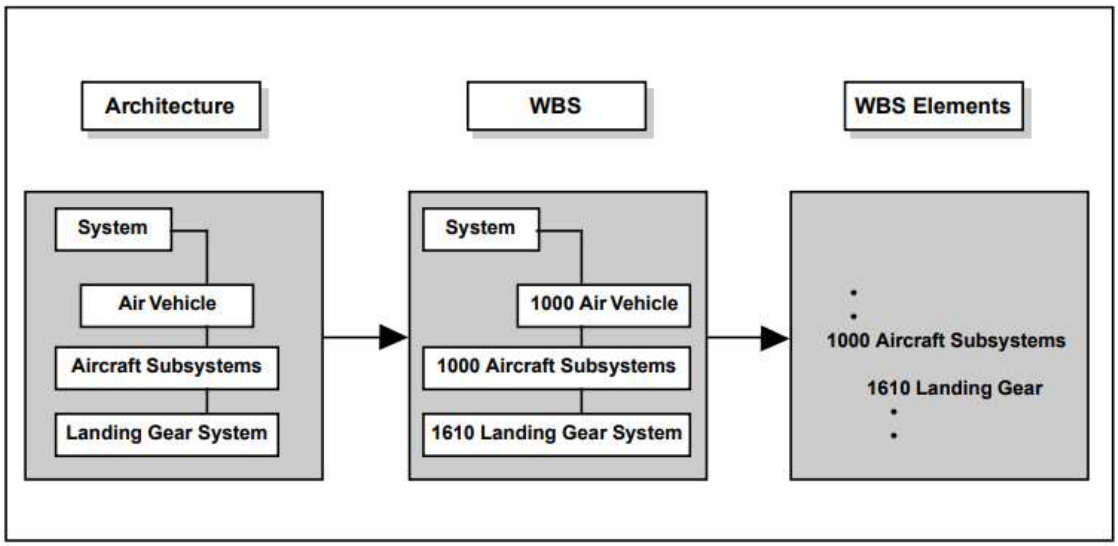

Figure 1: Architecture to WBS Flow [ocw.mit.edu].

WBS Role in DoD Systems Engineering

A programme WBS must be prepared in accordance with DoD 5000.2-R to serve as a framework for programme and technical planning, cost estimation, resource allotment, performance monitoring, and status reporting. The WBS is used to describe the overall system, show it as a product-oriented family tree made up of hardware, software, services, data, and facilities, and to connect each of these components to the final result. Programme offices are required to modify a programme WBS in accordance with the instructions in MIL-HDBK-881.

The first three levels are originally defined by the WBS programme. Programme managers should ensure that the WBS is extended to identify all high-cost and high-risk elements for management and reporting as the programme develops and is further defined. They should also ensure that the contractor has full flexibility to extend the WBS below the reporting requirement to reflect how work will be accomplished [7], [8].

Basic Purposes of the WBS

Organizational:

A coordinated, comprehensive, and all-encompassing picture of programme management is provided by the WBS. It provides a framework for planning system development tasks including IPT design, development, and upkeep.

Business:

It gives budgets and cost projections a framework. The Cost Performance Reports or Cost/Schedule Control System Criteria reporting uses it to organise the gathering and analysis of detailed expenses [9], [10].

Technical:

The WBS provides a framework for:

1. Recognising goods, procedures, and information,
2. Planning the study and monitoring of risk,
3. Facilitating data administration and setup.
4. It aids in the identification and control of interfaces.
5. creating work packages for work orders and procuring materials and parts;
6. Planning technical audits and evaluations.

The WBS is used to organise product components for the creation of specifications, to create Statements of Work (SOW), and to pinpoint particular contract deliverables.

Benefits WBS

The WBS enables a logical division of product parts into work packages, which allows the overall system to be defined. A WBS that has been properly created will track all programme activities. It makes initial budgets easier to create and makes future cost reporting less complicated by connecting programme goals and activities with resources. Utilising the WBS, it is possible to compare several independent indicators and other data in order to identify broad patterns. All programme activities, including programme and technical planning, event schedule development, configuration management, risk management, data management, specification preparation, SOW preparation, status reporting and issue analysis, cost estimations, and budget formulation—all of these are built upon it.

Development of WBS

The WBS is created using the physical and system architectures. The architectures should be examined to make sure that all essential goods and services have been recognised and that all jobs may continue to flow down from the top in accordance with the top-down structure. To select work packages for cost and schedule management, sufficient levels must be offered. The administration of work packages may suffer from poor integration and visibility if there are too few levels designated. Programme review and control measures could take too much time if there are too many levels specified.

These are the first three WBS Levels in order:

1. Level 1: The Whole System
2. Major Element (Segment) at Level 2
3. Subordinate Components (Prime Items) at Level 3

The levels below the first three reflect the deconstruction of a component to the level of a configuration item. In general, the top three levels are developed by the government, while levels below three are developed by a contractor or contractors.

DoD Procedures

The programme office creates a programme WBS and a contract WBS for each contract in line with DoD statutory procedures in DoD 5000.2-R and customary DoD practise as stated in MIL-HDBK-881. The programme WBS, also known as the WBS that specifies the system architecture, is the WBS that represents the whole system. The portion of the programme WBS that corresponds to the deliverables and tasks of a particular contract is known as the contract WBS. The programme office uses MIL-HDBK-881 to help the systems engineering process in creating the first three levels of the programme WBS and to provide contractors direction for creating lower level WBSs. Use of MIL-HDBK-881 cannot be outlined as a contract obligation, as is the case with the majority of standards and handbooks. WBS creation affects contracting officers as well as cost and budget specialist's despite being a systems engineering function. To assist with WBS creation, a unified team composed of these stakeholders should be established.

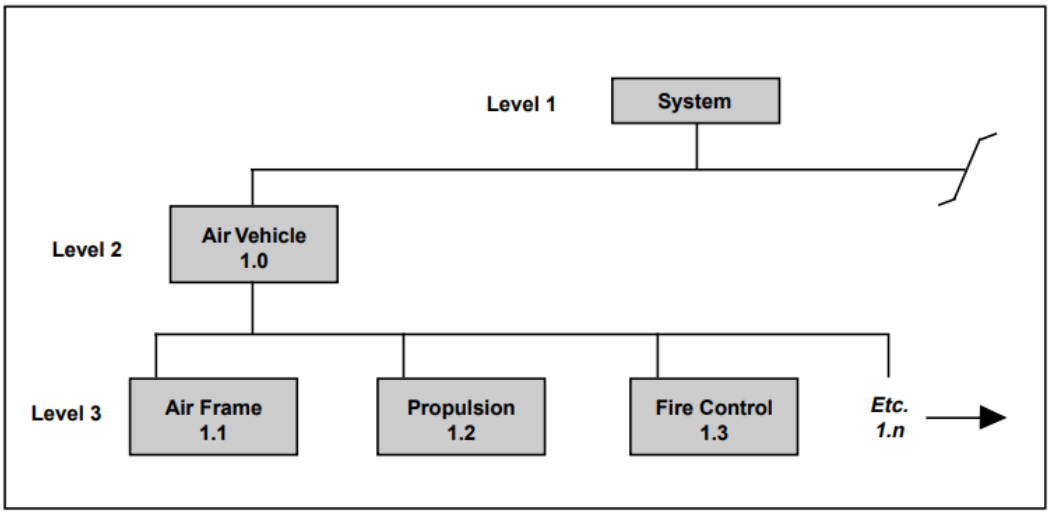

Figure 1: Program WBS – The Product Part (Physical Architecture) [ocw.mit.edu].

WBS Physiology

An end product and an enabling product are both parts of a programme WBS. The primary mission product(s) supplied to the operational client make up the end product portion of the system. The physical architectures created from operational needs serve as the foundation for this section of the WBS. It stands for the section of the WBS devoted to product development. A basic illustration of a programme WBS product portion is shown in Figure 2.

The system's "enabling product" component consists of the goods and services needed to create, manufacture, and provide support for the final product or products. This section of the WBS lists all the goods and services required to satisfy the life cycle demands of the product and includes the horizontal components of the system architecture (except the end products). An illustration of the first three levels of a full WBS tree is shown in Figure 3.

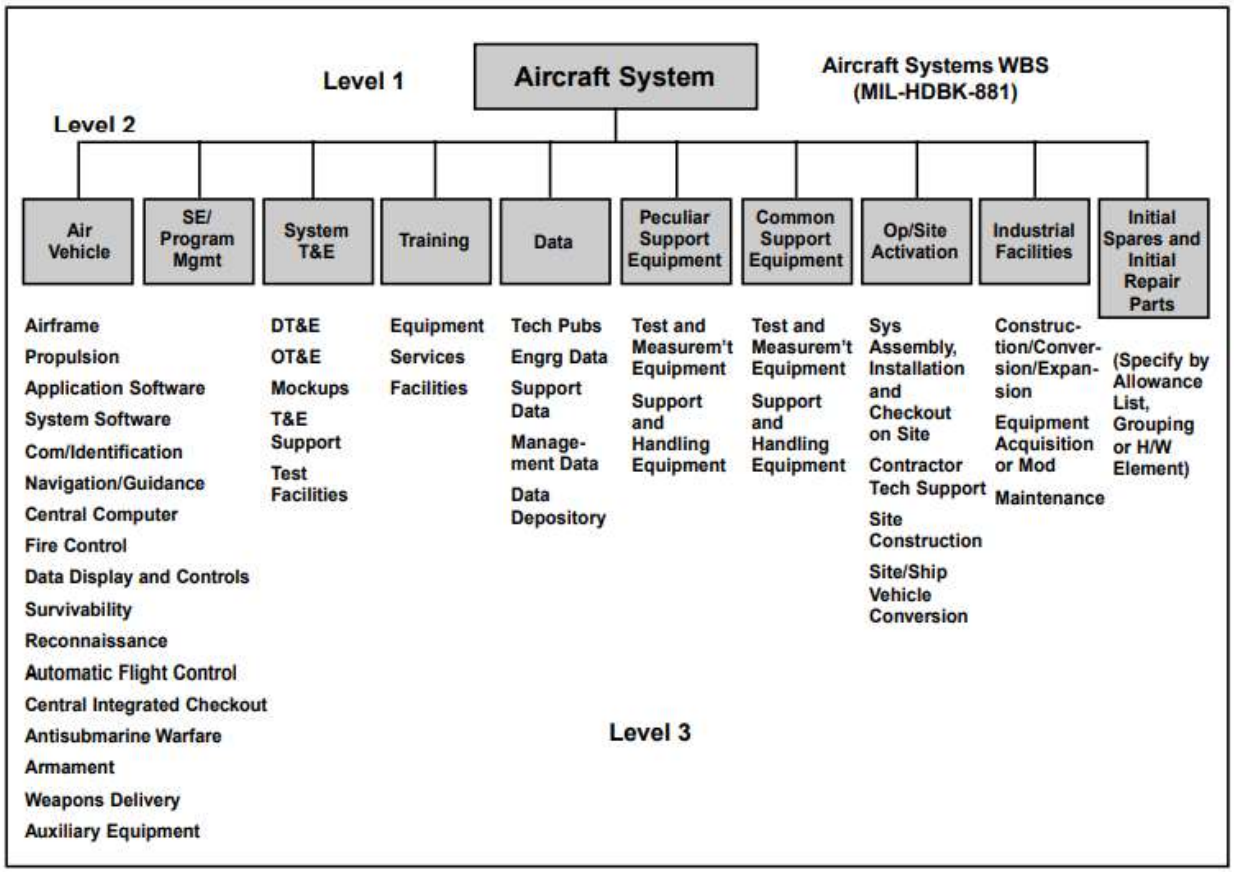

Figure 3: The Complete Work Breakdown Structure [ocw.mit.edu].

Agreement WBS

The programme office creates a contract WBS in order to prepare for contracting for the work necessary to construct the system. After contract award, the contractor continues to develop it. The section of the program's WBS that is expressly being tasked by the contract is known as the contract WBS. Figure 4 is a straightforward illustration of a contract WBS derived from the programme WBS illustrated in Figure 2. Similar to Figure 2, Figure 4 simply shows the product portion of the contract WBS.

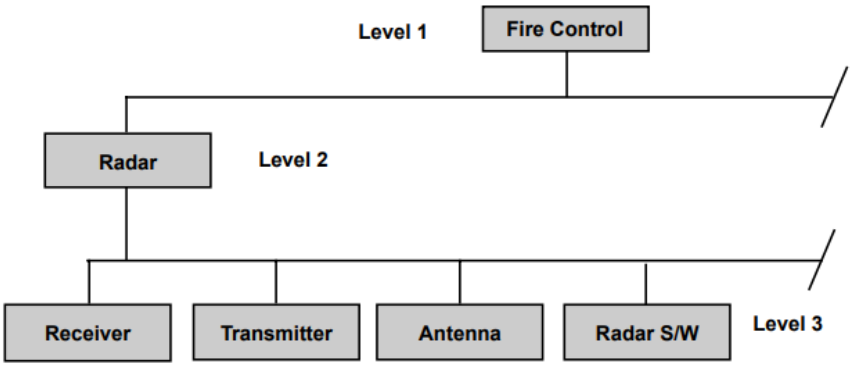

Figure 4: Contract WBS [ocw.mit.edu].

Work Design and Tracking

The WBS is primarily used for the planning and monitoring of activities. The WBS is used to determine what work is required, a means for organising feedback, and a logical breakdown into work packages. Figure 5 illustrates how the WBS element is matrixed against the firm organisations in charge of the job. This produces very comprehensive cost statements and job definitions. By assisting in the determination of the level of knowledge and functional support necessary for a given WBS element, it enables the reasonable organisation of integrated teams and other organisational structures. Furthermore, it enables accurate management and technical tracking.

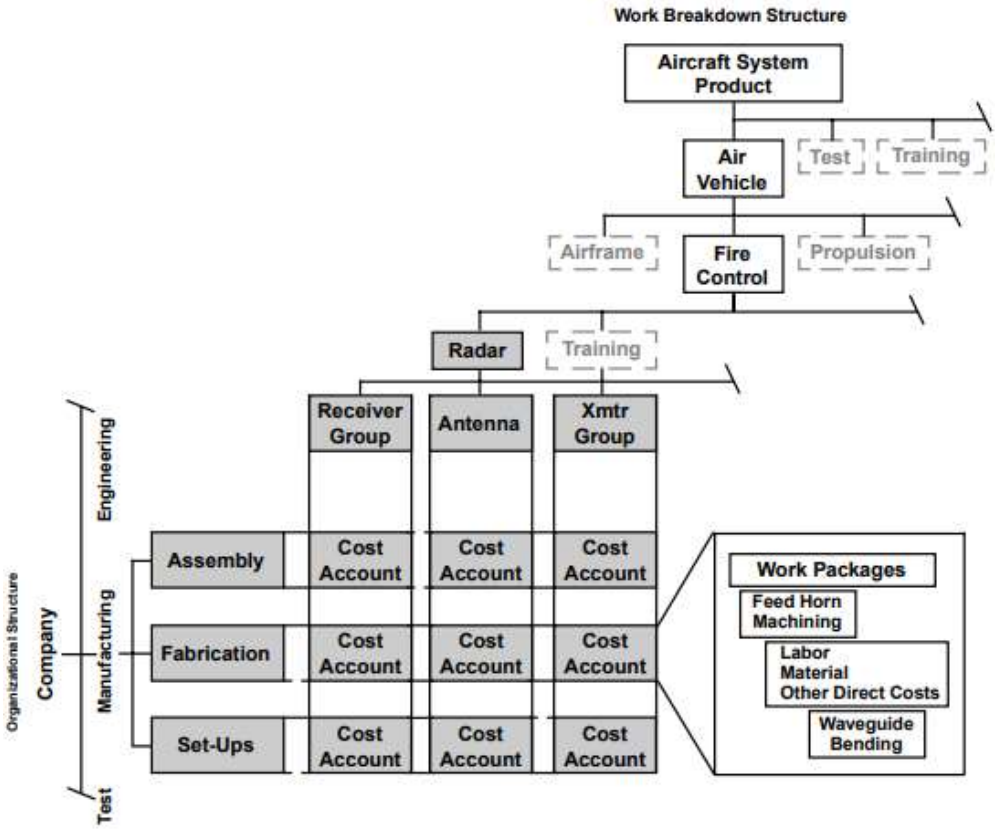

Figure 5: WBS Control Matrix [ocw.mit.edu].

Dictionary WBS

A Work Breakdown Dictionary is created as part of the usage of the WBS for work and expense management. A dictionary record is created for each WBS element that details the task, expenses (activities) that apply, and references the Contract Line Item Numbers and SOW text that go along with it. Figure 6 is an illustration of a level 2 WBS element dictionary entry.

<table>
<tr><td colspan="3">Index Item No. 2 WBS Level 2</td><td>CONTRACT NUMBER
F33657-72-C-0923</td></tr>
<tr><td colspan="2">WBS Element
A10100</td><td>WBS Title
Air Vehicle</td><td rowspan="2">Contract Line Item:
0001, 0001AA, 0001AB, 0001AC, 0001AD
0001AE, 0001AF, 0001AG, 0001AH</td></tr>
<tr><td>Date Chg</td><td>Revision No.</td><td>Revision Auth</td><td>Approved</td></tr>
<tr><td colspan="2">Specification No.
689E078780028</td><td colspan="2">Specification Title:
Prime Item Development Specification for AGM 86A Air Vehicle/ Airframe</td></tr>
<tr><td colspan="3">Element Task Description
Technical Content:
The Air Vehicle element task description refers to the effort required to develop, fabricate, integrate and test the airframe segment, portions of the Navigation/Guidance element, and Airborne Development Test Equipment and Airborne Operational Test Equipment and to the integration assembly and check-out of these complete elements, together with the Engine Segment, to produce the complete Air Vehicle. The lower-level elements included and summarized in the Air Vehicle element are:
Airframe Segment (A11100), Navigation/Guidance Segment (A32100), Airborne Development Test Equipment (A61100), and Airborne Operational Test Equipment (A61200).</td><td>Cost Description
MPC/PMC
A10100
Work Order/Work Auth
See lower level WBS Elements
Cost Content – System Contractor
The cost to be accumulated against this element includes a summarization of all costs required to plan, develop, fabricate, assemble, integrate and perform development testing, analysis and reporting for the air vehicle. It also includes all costs associated with the required efforts in integrating, assembling and checking our GFP required to create this element.
Applicable SOW Paragraph
3.6.2</td></tr>
</table>

Figure 6: Work Breakdown Dictionary [ocw.mit.edu].

Beyond the technical community, business professionals and contractual authorities also value it. Its development must take into account the requirements of all stakeholders. For each contract, the programme office creates a high-level contract WBS in addition to the programme WBS. The lowest tiers of the WBS for the contract that the contractors are working on are developed. The framework for a programme WBS is provided by the system architecture. From this WBS, SOW tasks flow. The WBS offers a framework for categorising IPTs and keeping track of KPIs.

III. CONCLUSION

The Work Breakdown Structure (WBS), which aids in organising, planning, and carrying out large projects, is a crucial tool in project management. It gives project managers and team members a hierarchical breakdown of the project's deliverables, activities, and tasks so they can successfully manage and control the project. The WBS has several advantages for project management. By dividing the project into manageable parts, it enables stakeholders to have a clear grasp of the project's needs and scope. With the use of this breakdown, project goals may be clarified, resources and deadlines can be estimated, and dependencies and important routes can be found. The WBS enables efficient planning and scheduling by breaking the project down into smaller work items. It helps project managers to distribute resources, establish benchmarks, and monitor development at every stage of the work breakdown structure. This makes ensuring that tasks are clearly defined, given to the right team members, and finished by the deadlines.

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