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Features Of Implementing a Work Breakdown Structure in Multidisciplinary Projects

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Abstract: The article examines the implementation of a work breakdown structure in multidisciplinary projects and its role in ensuring consistency in planning, budgeting, and quality control. The relevance of the study is justified by the need to coordinate diverse engineering and scientific schools accustomed to their work-structuring templates, which, without a common decomposition language, leads to package duplication, hidden interfaces, and risks of resource overrun. The objectives of the article are to analyze existing standards and practices, identify empirical patterns in how WBS quality influences project timeliness and budget compliance, and formulate methodological recommendations for harmonizing codes, terminology, and integration packages. The novelty of the research lies in the systematic comparative analysis of NASA guidelines and construction case studies, in the content analysis of buffer tasks according to the schedule margin methodology, and in the proposal of a classification of interface tasks along three axes (technical, contractual and organizational); the study demonstrates how to link the WBS-dictionary with digital PDM, PLM and PPM platforms to enhance transparency and adaptability of project structures. The main conclusions show that a properly constructed WBS functions not only as a work map but also as a mechanism for translation between professional languages, ensures traceability of budget, schedule and requirements, and that integration and interface packages, defined as autonomous elements, transform hidden dependencies into manageable planning objects; the applied empirical threshold rules (8/80, 4%, 40 hours), the RACI role model and schedule margin buffer tasks create a dynamic yet predictable framework capable of adapting to evolving

requirements. The article will be helpful to project managers, systems engineers, integration management specialists, and all those involved in planning and control of multidisciplinary projects.

Keywords: work breakdown structure, WBS, multidisciplinary projects, hierarchical coding, interface management, RACI, integration packages

Introduction

The work breakdown structure, WBS, in NASA methodology is defined as a product-oriented family tree encompassing hardware, software, services, and other deliverables, thereby providing comprehensive coverage of the entire project scope and forming the basis for planning, budgeting, and quality control (NASA, 2023). Thanks to the unambiguous hierarchy of the WBS code, it becomes the standard language for scheduling, cost estimation, configuration management, and risk control; without such a language, estimates are generated in different coordinate systems, rendering a consolidated overview unattainable.

Empirical data confirm the managerial value of this hierarchy. A study at Lagos State University revealed a moderate positive correlation between WBS quality and the on-time completion of construction works, with a correlation coefficient of 0.513 and a coefficient of determination indicating that the WBS accounts for 26.3% of the variance in the on-schedule metric (Rukayat et al., 2023). In other words, one in four delays can be eliminated solely through correct decomposition, which elevates the WBS from a mere reporting attribute to a direct lever of project outcome. An analysis of civil engineering projects published in Applied Sciences complements this finding: the authors associate both insufficient and excessive work-package detailing with cost overruns and schedule disruptions, and stress that decomposition boundaries should be defined by clear control-fitness criteria rather than arbitrary technical levels (Narváez et al., 2020).

When different engineering and scientific schools, each accustomed to their work-structuring templates, converge in a single project, a unified WBS encounters specific challenges. Terminological discrepancies, for example, the term prototype, lead to package duplication; varying levels of detail obscure critical interfaces. To coordinate such heterogeneous environments, it is necessary to agree in advance on a standard coding system, to establish a glossary of terms and to allocate within the WBS separate packages for the development and validation of interdisciplinary interfaces, as recommended in the NASA handbook, where interface tasks are treated as equal elements of the hierarchy rather than appendages to primary deliverables (NASA, 2023). Such practice renders integration costs transparent and allows buffers for change coordination to be incorporated into the baseline plan.

Thus, in a multidisciplinary environment, the WBS serves not only as a work map but also as a mechanism for translation between professional languages, ensuring traceability, comparability, and adaptability of the project in the face of inevitable requirement changes. It is this linking function that sets the tone for the subsequent analysis of WBS development features for complex projects, where success is measured not only by the depth of expert knowledge but also by the ability of different disciplines to operate as a unified system.

Materials and Methodology

The study is based on the analysis of 17 sources, including the NASA Work Breakdown Structure Handbook (NASA, 2023), Government Accountability Office recommendations on project cost management (GAO, 2020) and the international standard ISO 21511 (ISO, 2018); empirical investigations of the relationship between WBS quality and work delivery success: statistical analysis of projects at Lagos State University (Rukayat et al., 2023) and the integration of work and cost structures in civil construction (Narváez et al., 2020); interface management case studies in megaprojects (Interface Management, 2022) and the application of schedule margin buffer tasks (Newbold et al., 2010); empirical threshold rules for determining work-package size 8/80 and 40 hours (Roland Wanner, 2020; Taylor, 2015); analysis of the role of the RACI matrix in responsibility allocation (Matthews, 2024) and barriers to change escalation (KPMG, 2024); as well as examples of digital integration of PDM, PLM and PPM in collaborative CAD projects (Asuzu et al., 2024).

Methodologically, the study combines: comparative analysis of decomposition approaches based on the NASA handbook and construction case results, with evaluation of detail levels and element coding; systematic review of WBS-dictionary requirements in accordance with ISO 21511 and NASA configuration-management practices; content analysis of integration packages and buffer tasks aimed at identifying best practices for transparent accounting of time and cost risks; empirical pilot testing of decomposition depth within a rolling-wave framework with six-week detailing and measurement of labour efforts; classification of interface tasks along technical, contractual and organizational axes (PMI, 2024); application of the empirical 8/80 and 4 % rules to substantiate package-detailing limits; analysis of the effectiveness of the RACI matrix and change-control procedures; and evaluation of the impact of digital-platform integration (PDM, PLM and PPM) on WBS traceability and consistency in a multidisciplinary environment.

Results and Discussion

At the preparatory stage, the key task is to create a complete picture of all disciplines that contribute to the project outcome, as the completeness of the future hierarchy depends on this initial inventory. NASA's WBS guidelines emphasize that the structure should cover both in-house work and the efforts of contractors and partners; otherwise, the traceability of the budget, schedule, and requirements will inevitably face gaps (NASA, 2023). Once the list of disciplines is finalized, a WBS architect is appointed to be the custodian of the decomposition logic. In large-scale NASA space programs, this role is fulfilled by the Integrated WBS Manager, who coordinates the boundaries between engineering, software, and operational domains and administers changes to the element codes, ensuring a unified reporting format for the entire team (NASA, 2023). The absence of such a coordinator leads to disciplines fragmenting the structure according to their own rules, and a no-man's land of responsibility arises at the intersections, increasing the burden on integration.

The third task of the preparatory stage is to formulate the objectives of the decomposition, and these objectives must be quantitative. If the project aims to control costs using the Earned Value methodology, the package must contain a measurable outcome that can be linked to actual labor costs. If rapid prototype integration is critical, the boundaries of the package should follow the interfaces, allowing defects to be detected in early assemblies. Field data from construction confirm that when work packages exceed four percent of the total budget, the risk of losing control increases sharply; therefore, the upper limit of detailing should be methodically fixed rather than left to the discretion of the executors (Narváez et al., 2020).

Decomposition principles begin with an output-oriented approach: an element is added to the structure only when it is expressed in a tangible product, document, or verifiable service. This logic enables the project goal achievement plan to be directly linked to the project's outputs, simplifying decision-making regarding resource allocation and prioritization. Next, a tiered rule product, module, and discipline is applied: at the first level, the final subsystems or functional segments are represented; at the second level, modules ensuring autonomous development are displayed; at the third level, disciplinary packages that a specialist can directly control are shown. This three-tiered scheme, recommended by NASA and supported by the results of construction project analysis, minimizes the number of overlaps between teams and provides a transparent picture of dependencies between timelines and costs (NASA, 2023).

Finally, hierarchical numbering turns the structure into an addressing system. In space projects, no more than seven levels are allowed, with each new level adding at least two digits. Contractor codes inherit upper elements without altering the format. This approach enables the automatic aggregation of reports from various sources and prevents discrepancies when merging databases (NASA, 2023). The combination of stable coding and unified detailing rules forms the basis for further discipline integration, eliminates work duplication, and creates a reliable platform for cost and schedule analysis throughout the project lifecycle. According to Grand View Research, the global market for project management software that facilitates WBS construction and integrates multidisciplinary processes was valued at USD 6.59 billion in 2022 and is projected to reach USD 20.47 billion by 2030, with a compound annual growth rate (CAGR) of 15.7% from 2023 to 2030, as shown in Figure 1 (Grand View Research, 2023).

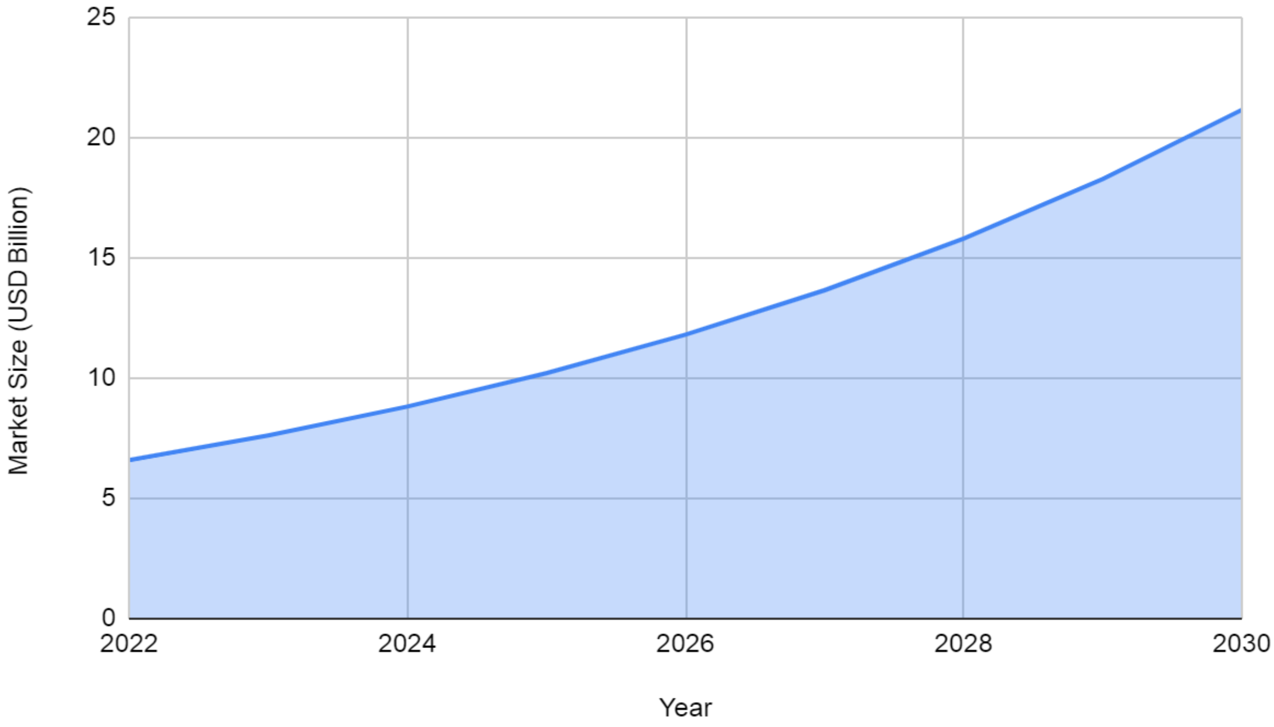

Fig. 1. The global project management software market size (Grand View Research, 2023)

Having completed the coding of levels and delineated the boundaries of work packages, the team proceeds to linguistic unification, since any ambiguity in terminology immediately translates into planning and reporting errors. The international standard ISO 21511 defines the WBS dictionary as a mandatory annex, in which each element is accompanied by an accurate description of scope, deliverables, and constraints, thereby ensuring that project participants interpret identical codes in the same manner (ISO, 2018). An analogous requirement is outlined in the NASA guide: the project is required to maintain a WBS dictionary aligned with the financial system up to and including the seventh level; otherwise, costs cannot be accurately aggregated according to the structure (NASA, 2023).

Practice demonstrates that the absence of a formalized dictionary has a direct impact on project losses. A study of the Lebanese construction sector found that design errors account for 65% of project variations, and a further 30% are attributed to late design changes, both groups of causes relying on initially inaccurate or contradictory task definitions (Azar et al., 2018). Therefore, glossary development begins concurrently with decomposition rather than afterwards. The working group records each term, its working definition, units of measurement, and reference documents, agrees on the entry with representatives of all disciplines, and secures it in the configuration-management system.

The next step is to link terms to WBS elements. Each code is assigned a unique reference to the dictionary, which allows automated tools to insert the description into schedules, estimates, and contracts. NASA illustrates this in its NSM system example, where an approved code cannot be deleted and remains a unified key for financial and engineering data throughout its lifecycle (NASA, 2023). In practice, such an ‘address’ transforms the dictionary into an interface between engineering models, accounting, and Earned Value reports, thereby eliminating nomenclature discrepancies between packages, books, and estimates.

A formal update procedure overcomes the static nature of the dictionary. The project introduces a rule whereby any change to a term follows the same configuration-control process as a requirements change: the initiator submits a request, and the WBS architect analyzes its impact on related elements (Cretu, 2025). The change is ratified at the monthly integration meeting. The publication of a new glossary version is accompanied by the distribution of notifications and the automatic reconstruction of reports, with each change recorded in the revision log. This cycle renders the dictionary a ‘living’ document while preserving full traceability.

Thus, terminology harmonization converts the

WBS from a mere set of codes into a comprehensive knowledge environment: the glossary establishes a unified conceptual framework, the linkage to elements ensures the accuracy of adjacent systems, and the managed update process maintains synchronization of disciplines when requirements change. These measures minimize work duplication and enable the timely identification of potential conflicts before they evolve into budget overruns and schedule slippages.

The optimal depth of decomposition determines whether the team can simultaneously monitor critical risks and avoid being overwhelmed by management transactions. The US Government Accountability Office's cost-estimation guide notes that increased detailing in itself does not improve accuracy, and if a project attempts to schedule elements too early and too thoroughly, the quality of the estimate declines because early-stage data remain incomplete (GAO, 2020).

The boundaries of 'too coarse' and 'too fine' are typically defined using a set of empirical rules. The 8/80 rule recommends that work in a package requires no fewer than eight and no more than eighty person-hours, otherwise control becomes either costly or meaningless (Roland Wanner, 2020). The 40-hour rule maintains a consistent range every week, while the 4% rule suggests discontinuing further subdivision when the package volume reaches approximately four percent of the total budget or one week in a six-month project, thereby providing a convenient scale for projects of varying sizes (Taylor, 2015). Alongside, Figure 2 illustrates a quantitative WBS-construction technique applying the 100 % Rule by allocating 100 points to the total project scope, subdividing those points into level 2 elements based on relative effort, progressively elaborating to level 3 and terminal elements coded with underscores for scheduling, and recommending the use of interactive software and collaborative team estimation.

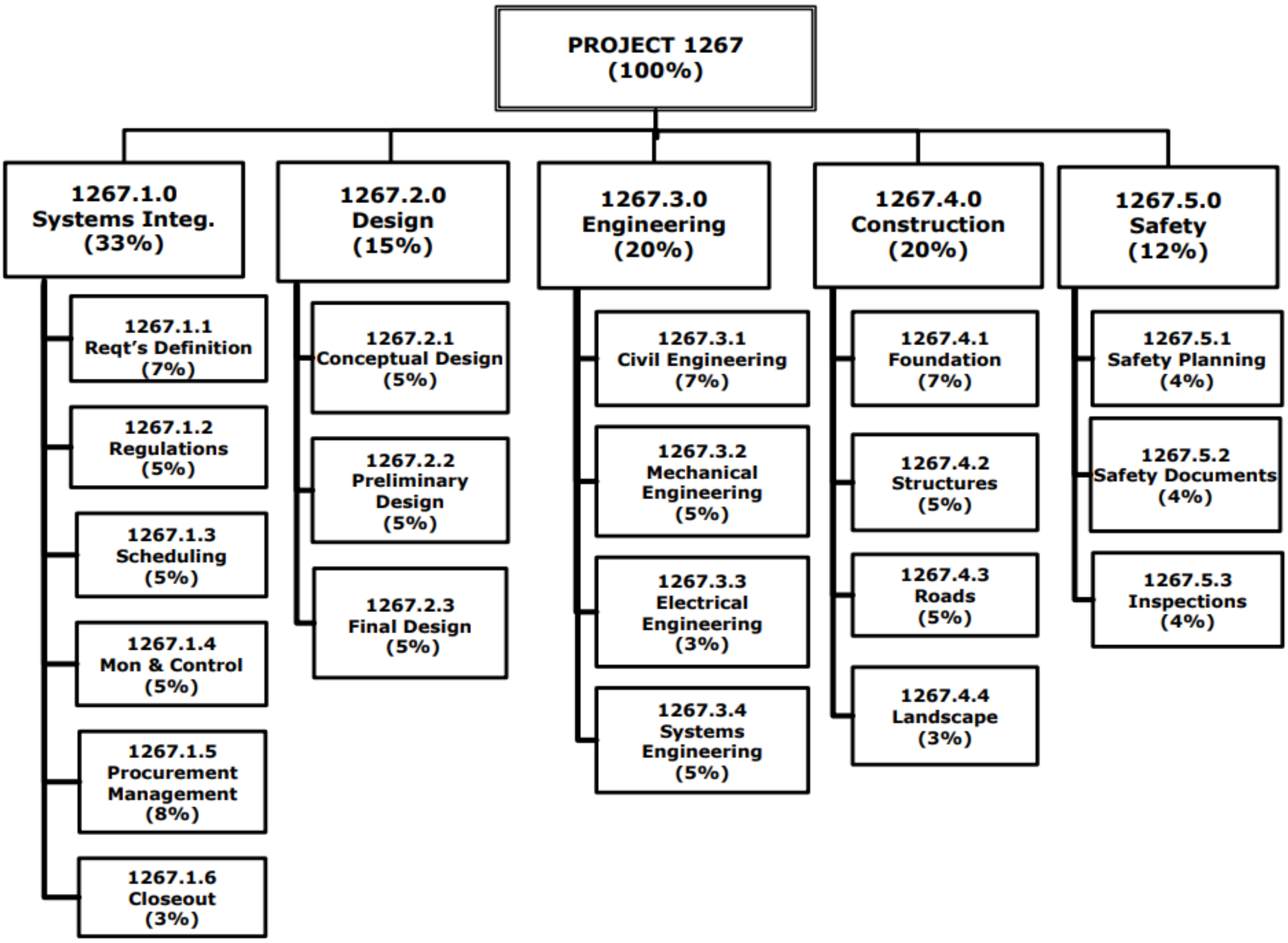

Fig. 2. Example of a Project WBS using the 100% Method (Taylor, 2015)

The just enough method relies on these threshold values and adds a check for controllability: a package is considered sufficient when it can be unambiguously estimated in terms of labor costs, assigned to a single responsible party, and completed within one reporting cycle. If, after applying the rules, uncertainty remains, the manager defaults to the smallest of the intervals; thus, the structure remains controllable, and the accounting costs do not grow disproportionately to the content itself (Roland Wanner, 2020).

Pilot decomposition serves as a practical test of these criteria: the team selects a typical work section, breaks it down to the end of the six-week horizon, and measures the labor intensity of reporting. Such a pilot easily fits into the rolling wave approach, where distant packages are kept as aggregated planning templates. As the deadline approaches, each template is divided into four- to six-week work packages, maintaining a continuous six-month layer of detailed information (GAO, 2020). Therefore, testing on the pilot segment confirms the applicability of the rules to the specific team and allows timely adjustment of the depth before the WBS is rolled out across the entire project.

Managing interdisciplinary dependencies begins with systematically identifying interfaces, as cost and schedule risks concentrate at the boundaries between disciplines. NASA's WBS guidelines require that interface-related work be assigned separate codes and tracked to the financial level, demonstrating that opaque junctions inevitably disrupt the scope, budget, and schedule link (NASA, 2023). A study of capital megaprojects found that interface management errors can absorb up to twenty percent of the total estimate, meaning one in five expenditures is not related to technology but to poorly defined boundaries of responsibility (Interface Management, 2022).

In practice, interfaces are best classified along three axes: technical, contractual, and organizational. This triple classification, proposed by analysts at the Project Management Institute, facilitates the selection of control tools: technical interfaces are best managed with engineering reviews, contractual interfaces with fixed acceptance points, and organizational interfaces with communication protocols (PMI, 2024), an example of which is shown in Figure 3. Classifying at the planning stage reduces the share of hidden dependencies and simplifies subsequent change coordination.

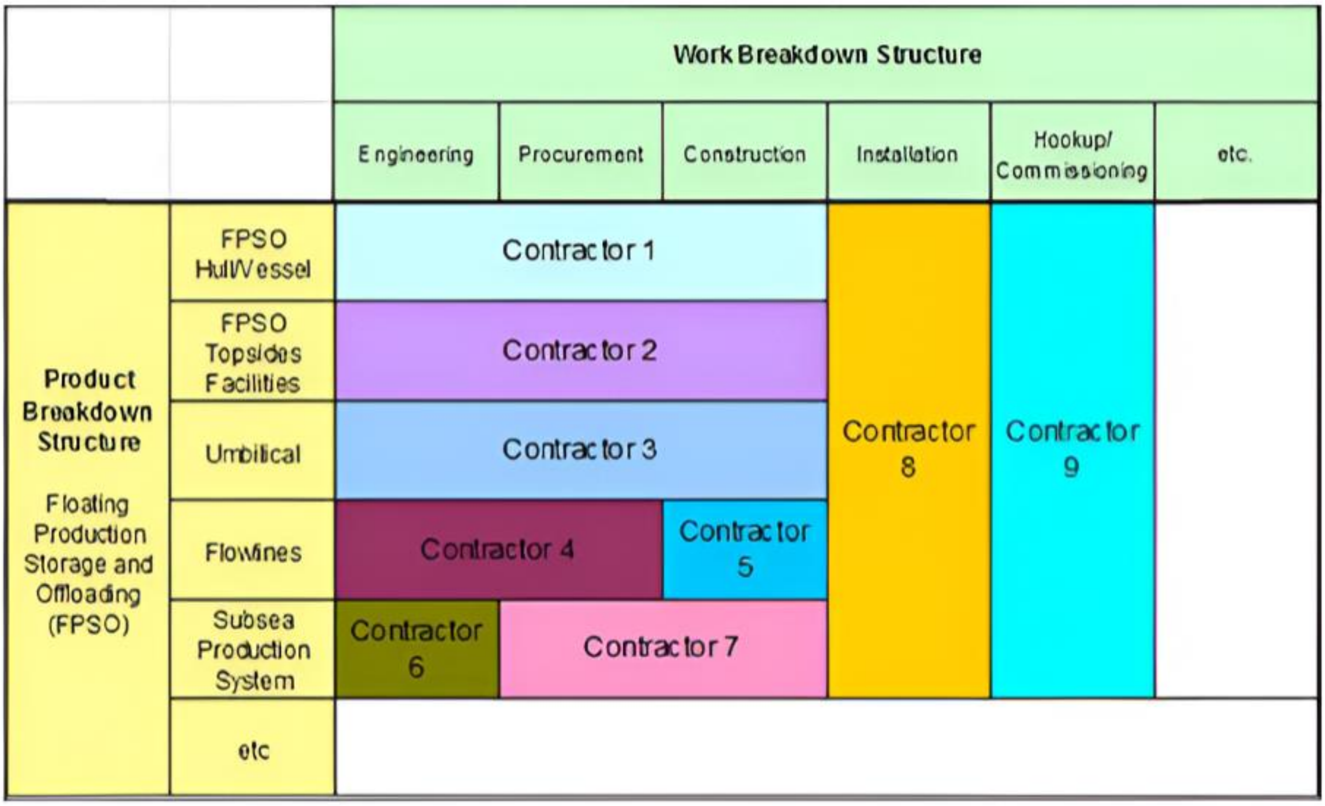

Fig. 3. Sample contract breakdown structure for an offshore project (PMI, 2024)

After the inventory of interfaces, the team forms integration packages and enters them into the WBS alongside product tasks. This approach converts invisible coordination into visible cost and makes it an object of the plan-versus-actual comparison. NASA's guide emphasizes that without separate codes for integration, labor costs cannot be tied to control points; therefore, interface work must be included in the master plan and Earned Value reports, rather than being spread thinly across disciplines (NASA, 2023).

Even with thorough interface management, some uncertainty remains, so the schedule is supplemented with buffer tasks. The schedule margin methodology recommends inserting time reserves as independent network elements, which allows variability to be explicitly accounted for without distorting the SPI and CPI metrics. Practical guides for schedule protection note that using such buffers increases the predictability of completion dates without the need to redistribute costs, as buffer tasks themselves do not carry value and do not earn earned value (Newbold et al., 2010).

For interface and buffer packages to be effectively managed, each element of the structure is linked to the RACI responsibility matrix. The one package—one responsible approach defines the roles of Responsible, Accountable for final approval, Consulted for expert support, and Informed for communication transparency. Project management materials from project-management.com show that a clear RACI link prevents overlaps in authority and simplifies task status control in complex projects (Matthews, 2024).

Linking packages to roles eliminates no-man's land areas, but only if the escalation process operates faster than the critical delay arises. A KPMG study on organizational barriers notes that internal silos and limited communication remain the leading obstacles to integration when roles are formally defined but unsupported by management channels. Including a separate column in RACI for the three levels of escalation—technical lead, control account manager, project board—allows unresolved issues to be escalated up the structure within one reporting cycle, thus minimizing the impact of organizational gaps (KPMG, 2024).

Thus, following the sequence of interface identification, integration packages, and buffers, RACI transforms interdisciplinary dependencies from hidden risks into manageable planning objects, reducing the likelihood of cost overruns and increasing decision-making transparency.

The presence of a unified tool environment stabilizes the logical structure of the WBS, as each software solution links previously described levels of decomposition to specific data objects and roles. In engineering projects, PDM and PLM are often integrated first. PDM stores the original CAD models and versions, while PLM tracks the entire product lifecycle, including links to requirements and manufacturing. As a result, their integration eliminates gaps between module and discipline even at the detailing stage.

To prevent discrepancies between the resource plan and the work hierarchy, PPM platforms are added to this linkage, forming a unified portfolio of tasks, budgets, and capacities. When work packages are handed over to external and distributed teams, cloud repositories for CAD and source code reduce transactional losses. In this digital environment, three project personas emerge—the guide, the integrator, and the communicator; they become the axes of the new responsibility matrix, helping to reflect minor adjustments in WBS elements without bureaucracy (Asuzu et al., 2024).

However, even perfect digital infrastructure does not protect the work structure from changes. Therefore, a two-tier classification system is introduced at the WBS level: light change corresponds to classes II/minor, where form, fit, and qualification are unaffected; full change is equivalent to class I/major and requires revisiting form, fit, and function, or product requalification. This scheme has been widely applied in aerospace programs, enabling the immediate recognition of whether a reallocation of lower-level packages is necessary or if attribute adjustments are sufficient (Ho, 2016).

The subsequent procedure is the same for both categories, but the depth of review differs. The standard cycle includes registering the change proposal, an automated approval route in PDM/PLM, updating the dictionary of terms, and tracing to the related WBS package code, after which a record is created in the project's configuration database; the form and necessary fields of this log are detailed in NASA’s systems engineering manuals, simplifying implementation in projects across industries (NASA, 2023).

The final line of defense is reserves. For the schedule, buffer tasks tied to integration milestones are utilized. In NASA’s terminology, these are referred to as funded or unfunded schedule margins, which are distributed proportionally to risks and gradually consumed as the project progresses (NASA, 2023).

Thus, the tool ecosystem, strict change typology, and managed reserves transform the WBS into a dynamic yet predictable framework: changes are recorded without loss of traceability, and resources and timelines remain aligned with previous levels of decomposition and the roles matrix.

Conclusion

The materials and empirical data presented in the article confirm that a well-structured decomposition framework in multidisciplinary projects becomes not just a work map, but a mechanism for translation between professional languages. A strict code hierarchy and a unified glossary of terms ensure the traceability of the budget, schedule, and requirements by all participants. The identification of integration and interface packages alongside product tasks translates hidden dependencies into manageable planning objects, and the introduction of buffer tasks makes uncertainty transparent while maintaining predictable deadlines without distorting key performance indicators.

The methodological principles of decomposition focus on tangible outcomes and include a level rule product, module, discipline, empirical thresholds for detailing depth, and pilot verification, ensuring a balance between detailing and control efficiency. The clear link between packages and roles, as defined by the RACI model, eliminates areas of ambiguity in responsibility. Meanwhile, the managed process of terminology updates via configuration management ensures that the glossary remains relevant throughout the project lifecycle.

The integration of the WBS with digital platforms, such as PDM, PLM, and PPM, creates a tool ecosystem where package codes are linked to engineering models, resources, and contracts, thereby preventing data duplication and discrepancies. Classifying changes as light and full, as well as managing reserves through independent schedule margin tasks, transforms the WBS into a dynamic yet predictable project framework that can adapt to changing requirements and ensure transparency and control throughout the implementation process.

References

1. Asuzu, C. M., Cheng, K., & Olechowski, A. (2024). The Personas of Cloud CAD Collaboration: A Case Study of a Team of CAD Professionals. *IEEE Transactions on Engineering Management*, *PP*(99), 1–38. https://doi.org/10.1109/TEM.2024.3409178
2. Azar, A. D., Militaru, C., & Mattar, C. P. (2018, July 1). *Construction Design-Phase Errors and Their Impacts on Project Performance: Case Study of Lebanese Local Applications*. https://www.researchgate.net/publication/343382254_Construction_Design-Phase_Errors_and_Their_Impacts_on_Project_Performance_Case_Study_of_Lebanese_Local_Applications
3. Cretu, V. G. (2025). *Planning Engineering - Principles and Memories* (English). Amazon. GAO. (2020). *Best Practices for Developing and Managing Program Costs*. GAO. https://www.gao.gov/assets/710/706933.pdf
4. Grand View Research. (2023). *Project Management Software Market Size*. Grand View Research. https://www.grandviewresearch.com/industry-analysis/project-management-software-market-report
5. Ho, N. (2016). *Process Change Assessment Techniques*. Aerospace. https://aerospace.org/sites/default/files/maiw/TOR-2016-02187.pdf
6. Interface Management. (2022). *Interface Management Improves On-Time, On-Budget Delivery of Megaprojects*. Interface Management. https://www.interfacemanagement.com/im/resources/interface-management-research/research/Interface-Management-Improves-On-Time-On-Budget-Delivery-of-Megaprojects
7. ISO. (2018). *ISO 21511:2018*. ISO. https://www.iso.org/standard/69702.html
8. KPMG. (2024). *Addressing the Strategy Execution Gap in Sustainability Reporting*. KPMG. https://kpmg.com/kpmg-us/content/dam/kpmg/pdf/2024/kpmg-2024-esg-organization-survey.pdf
9. Matthews, B. (2024, April 19). *Understanding the responsibility assignment matrix (RACI matrix)*. Project Management. https://project-management.com/understanding-responsibility-assignment-matrix-raci-matrix/
10. Narváez, A. C., Fernández, A. P., Mateo, M. O., & Pérez, P. B. (2020). Integration of Cost and Work Breakdown Structures in the Management of Construction Projects. *Applied Sciences*, *10*(4), 1386. mdpi. https://www.mdpi.com/2076-3417/10/4/1386
11. NASA. (2023). *NASA Work Breakdown Structure (WBS) Handbook*. NASA. https://www.nasa.gov/wp-content/uploads/2023/08/nasa-work-breakdown-structure-handbook.pdf
12. Newbold, R., Budd, C., & Budd, C. (2010). *Protecting Earned Value Schedules with Schedule Margin*. Prochain. https://www.prochain.com/wp-content/uploads/2024/09/ProtectingEVSchedules.

pdf

13. PMI. (2024). *Managing the complexity of engineering interfaces through ecollaboration*. PMI. https://www.pmi.org/learning/library/managing-complexity-engineering-interfaces-ecollaboration-1460

14. Roland Wanner. (2020, May). *How to Determine the Right Work Package Size and Duration*. Roland Wanner. https://rolandwanner.com/determine-the-right-work-package-size-and-duration/

15. Rukayat, P. O., Waliu, O., & ibrahim, olateju olawale. (2023, September 14). *Work Breakdown Structure and Timely Project Delivery*. https://www.researchgate.net/publication/373902508_Work_Breakdown_Structure_and_Timely_Delivery_of_Project_A_Study_of_Lagos_State_University

16. Taylor, M. (2015). *How to Develop Work Breakdown Structures*. Project Coach. https://projectcoach.com.mx/wp-content/uploads/2015/10/How-to-Develop-Work-Breakdown-Structures.pdf