

Getting the Most out of “Work Breakdown Structure”

PRESENTATION TO
INCOSE South Africa Chapter
Western Cape Branch

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What the Work Breakdown Structure is NOT

**A Work Breakdown Structure is NOT a
breakdown of work!**

What is a WBS (PBS)?

- A Work Breakdown Structure is a **product-oriented arrangement of products and services** that **reflects the plan for how the objectives of a project are to be satisfied - a WBS is a Project Breakdown Structure (PBS)**. The WBS/PBS will often evolve through the course of the project.
- A WBS/PBS relates the elements of work (services) to be accomplished to each other, to related end product(s) and/or services, and to intermediate and constituent products and/or services.




PBS/WBS - More

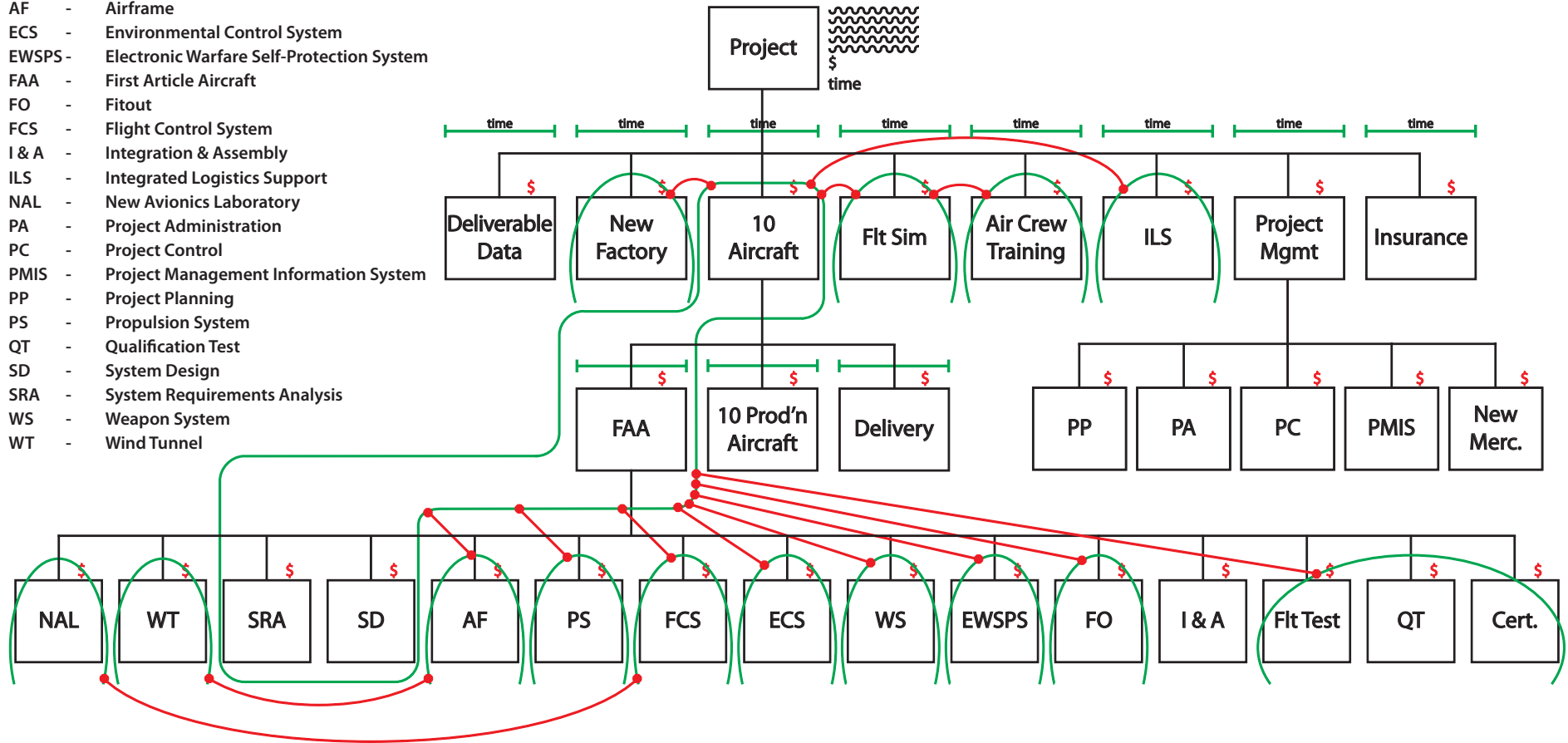
- Identifies and applies to a defined Project
- Displays and defines each Product and/or Service to be developed, produced and/or supplied by Project
- May be developed for a Program, and for each individual Contract or Project within the Program

Project (Work) Breakdown Structure (PBS/WBS)

as a Framework for Project Definition, Costing, Scheduling, Risk Analysis, Measurement, Reporting and Organizational Design

Legend:

-  Boundary of scope of an Integrated Product Team
-  Cross-team membership
-  Schedule: start and finish
- AF - Airframe
- ECS - Environmental Control System
- EWSPS - Electronic Warfare Self-Protection System
- FAA - First Article Aircraft
- FO - Fitout
- FCS - Flight Control System
- I & A - Integration & Assembly
- ILS - Integrated Logistics Support
- ILS - Integrated Logistics Support
- NAL - New Avionics Laboratory
- PA - Project Administration
- PC - Project Control
- PMIS - Project Management Information System
- PP - Project Planning
- PS - Propulsion System
- QT - Qualification Test
- SD - System Design
- SRA - System Requirements Analysis
- WS - Weapon System
- WT - Wind Tunnel



Systems engineering activities populate the WBS below level 2, or if there is only one deliverable of the project, at level 2 and below.

What is the purpose of a PBS/WBS?

A PBS/WBS provides a framework for:

- the definition of products to be realized and work tasks to be performed, directly related to the creation of project deliverables/outcomes
- the allocation of responsibility and authority for product realization and work task performance
- costing and scheduling, initially and ongoing, including EVM
- specifying, measuring and controlling the quality, cost and schedule attributes of the intermediate products and work tasks from which the deliverables are to be realized
- contracting and subcontracting intermediate products and work tasks
- analyzing, measuring and reporting project risk and its origins.

Purposes of a PBS/WBS - More

Organizational:

- Roadmap for concurrent management of elements of the project
- Provides a structure for defining multi-disciplinary product teams
- Provides a structure for designing team membership, with horizontal and vertical integration
- Provides a structure for deciding participation in technical reviews and audits

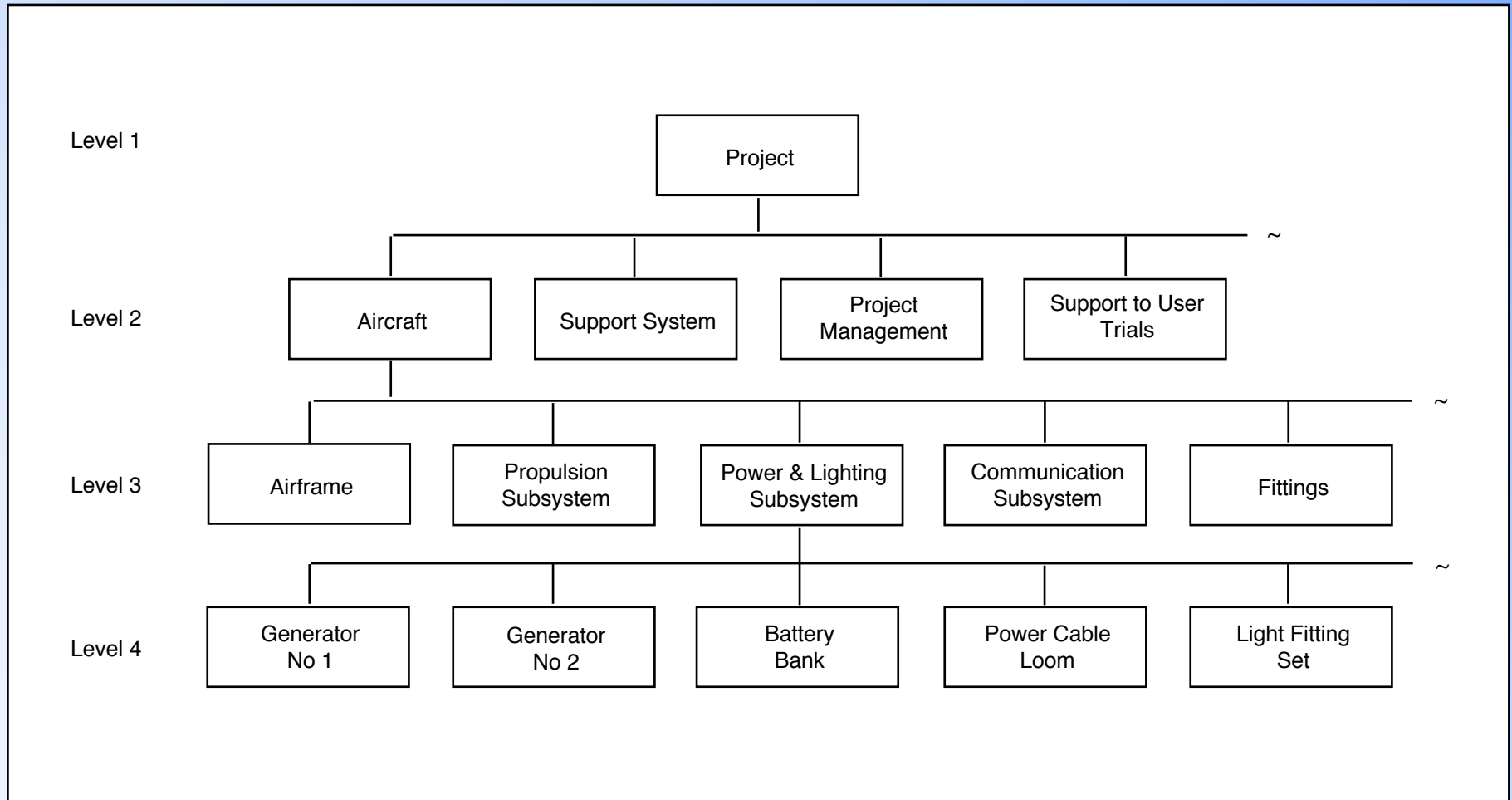
Technical:

- Relates to Statement of Work (SOW) and contract line item development
- Product Tree for technical efforts
- Provides a structure for interface identification & control
- A tool for managing Engineering Change Proposals (ECPs)
- Provides a structure for Work Package authorization, for conduct of work, and for materials/parts ordering
- Provides a structure for technical reviews and audits

Components of a PBS/WBS

- **PBS/WBS Index**, a **hierarchical structure of products and services** expressed graphically or as an indented list.
- **PBS/WBS Dictionary**, which **describes the scope of each PBS/WBS element**, such that the aggregation of the scopes under each entry in the PBS/WBS Dictionary encapsulates all products to be acquired/produced and all services to be performed in the realization of that element.
- The PBS/WBS Dictionary should be only as detailed as is necessary to permit **unambiguous association** of every hour of **labor** and every unit of **currency** of **expenditure** with the corresponding PBS/WBS element.

Additional Example PBS/WBS Index (Graphic)



Example PBS/WBS Index (Indented List)

0	Project	
1	Aircraft	
1.1		Aircraft Systems Engineering
1.1.x.....		.....
1.2		Propulsion Subsystem
1.2.x.....		.....
1.3		Power & Lighting Subsystem
1.3.1		Generator No 1
1.3.2		Generator No 2
1.3.3		Battery Bank
1.3.4		Power Cable Loom
1.3.5		Light Fitting Set
1.3.6		Power & Lighting Subsystem Design
1.3.7		Power & Lighting Subsystem Integration
1.3.8		P&L Systems Engineering
1.4		Communication Subsystem
1.4.x.....		.....
1.5		Fittings
1.5.x.....		.....
1.6		Aircraft System Integration
1.6.x.....		.....
2	Support System	
2.x.....		.....
3	Project Management	
3.x.....		.....
4	Support to User Trials	
4.x.....		.....
5	Flight Simulator	
5.x.....		.....
6	Production System	
6.x.....		.....
7	User Training	
7.x.....		.....

Example PBS/WBS Dictionary Page

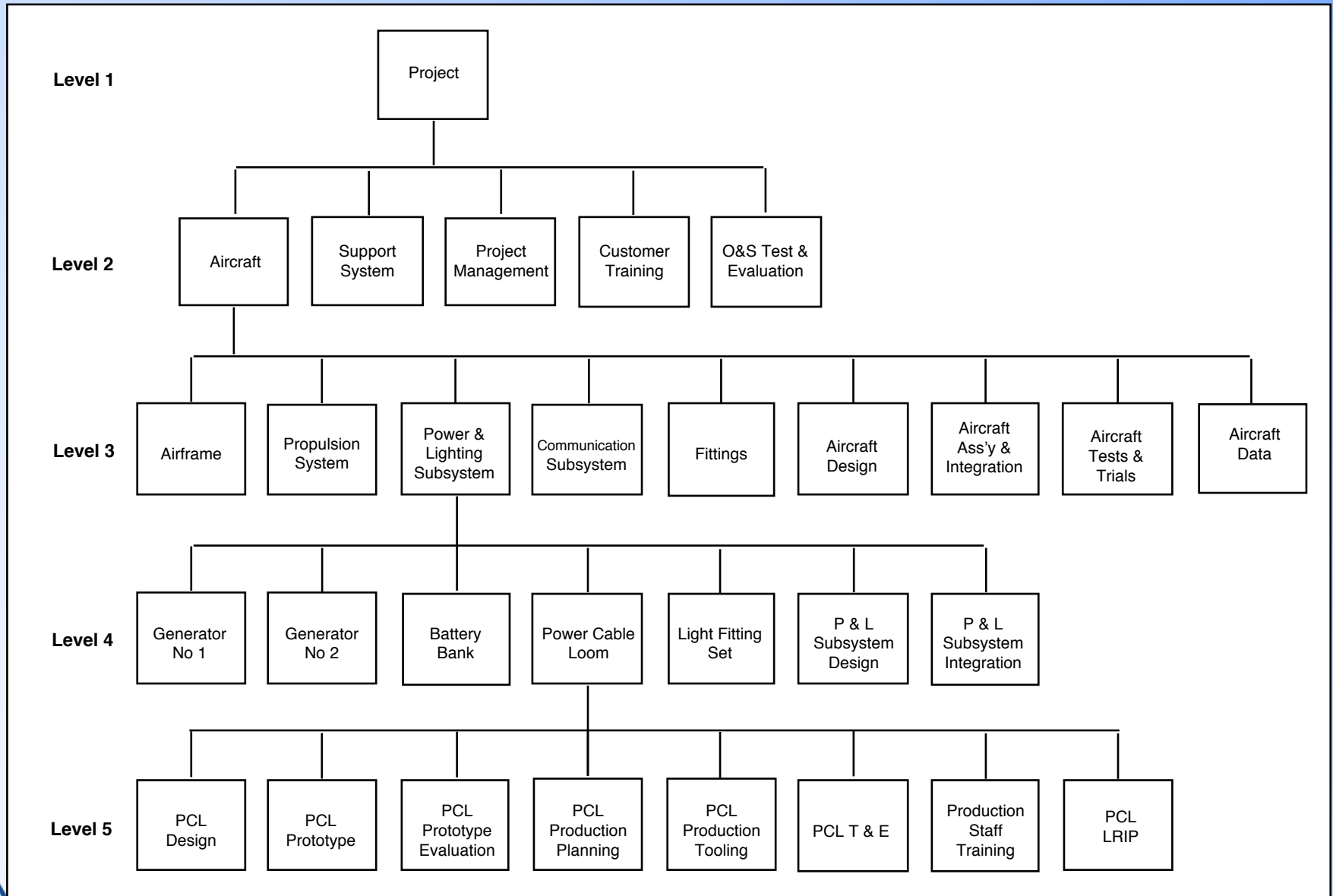
Project: <i>New Aircraft</i>	Work Breakdown Structure Dictionary	WBS Element No: <i>1.3</i>	
Contract No: <i>xxx.xxxxxx</i>		Sheet No: <i>1</i>	of: <i>1</i> sheets
Checked: Approved: (Date & Signature)		Element Title: <i>Power and Lighting Subsystem</i>	Revision No: <i>original</i>	Date of Revision: 3/9/93
<p>Element Description:</p> <p><i>The Power and Lighting Subsystem element is a summary element which refers to that equipment which transforms rotary motion from the aircraft engines into electrical power; stores the electrical energy, distributes the electrical power to other elements which use that power and provides and control s illumination internal and external to the aircrft which is not provided by means integral to other equipments.</i></p> <p><i>The element includes all efforts to design, develop, integrate and test the above equipment and the overall Power and Lighting Subsystem.</i></p> <p><i>The element excludes installation and checkout of the Power and Lighting Subsystem into the airframe.</i></p> <p style="text-align: right;">Attach continuation sheet(s) if necessary.</p>			
Interfacing Elements at the Same Level			
Element No.	Element Title		
<i>1.1</i>	<i>Airframe</i>		
<i>1.2</i>	<i>Propulsion</i>		
<i>1.4</i>	<i>Communications</i>		
<i>1.5</i>	<i>Fittings</i>		
<i>1.6</i>	<i>Aircraft System Assembly and Integration</i>		
Subordinate Elements at the Next Level			
Element No.	Element Title		
<i>1.3.1</i>	<i>Generator No 1</i>		
<i>1.3.2</i>	<i>Generator No 2</i>		
<i>1.3.3</i>	<i>Battery Bank</i>		
<i>1.3.4</i>	<i>Power Cable Loom</i>		
<i>1.3.5</i>	<i>Light Fitting Set</i>		
<i>1.3.6</i>	<i>Power and Lighting Subsystem Design</i>		
<i>1.3.7</i>	<i>Power and Lighting Subsystem Integration</i>		

TAA-XP-EN-000889-1 Technology Australasia Pty Limited

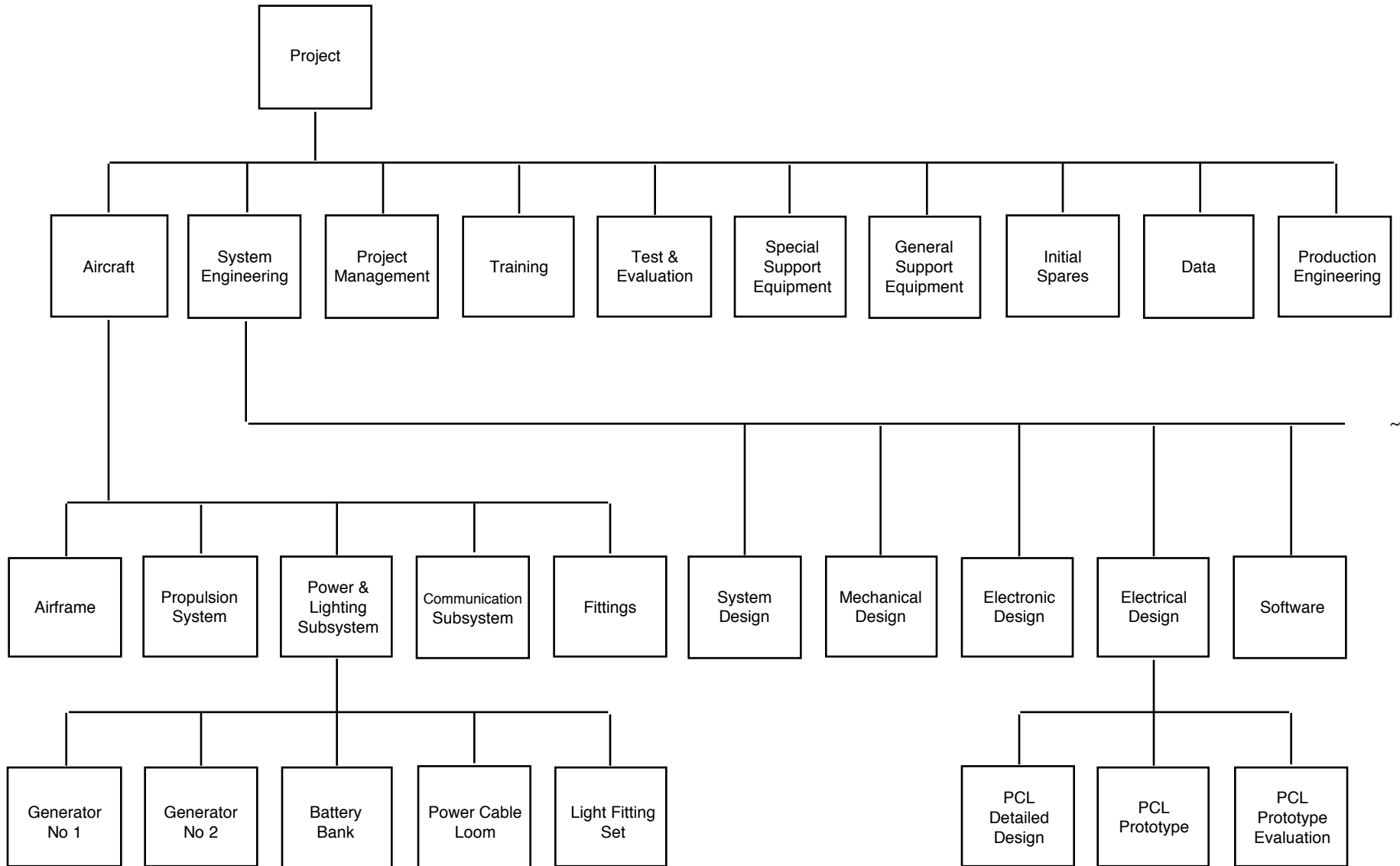
The PBS/WBS must be product-oriented

- **To be product-oriented**, each element of the PBS/WBS incorporates at the next level down (if any) **all of the products, materials and services, whether part of a deliverable or not, which need to be brought together to create the higher level element.**
- The set of products, materials and services reflects the plan for creating the element (product) or performing the element (service).
- Product-orientation contrasts with functional orientation.

Example Product-Oriented PBS/WBS



Example functionally-oriented PBS/WBS



Advantages of the Product-Oriented PBS/WBS

- **Product:** each set of adjacent elements in a branch represents the set of contained elements which has to be brought together (integrated) to realize the containing element up to the level of deliverable. **Functional:** no such relationship exists
- **Product:** each set of adjacent elements in a branch is a logical grouping for schedule planning purposes, since the starts and finishes of contained elements define the overall start and finish for the containing element up to the level of deliverable. **Functional:** no such relationship exists
- **Product:** the requirements of the containing element directly drive the requirements of each contained element. A requirements orientation towards the end result is fostered. **Functional:** the required end result tends to get lost
- **Product:** provides a natural framework around which to design a program of technical review and other verification activity, resulting in early discovery and correction of errors. **Functional:** provides no such framework
- **Product:** provides a natural framework for the definition of supplier/customer relationships within the project, including internal supplier/customer relationships. **Functional:** provides no such framework

Development Logic for Project (Work) Breakdown Structure – PBS (WBS) Project that has two or more deliverables

The level 1 element is the project.

To define level 2 elements:

1. What products (physical/software/data) are required to be delivered by the project?
2. What services are required to be delivered by the project?
3. What services are necessary, internal to the project, to deliver the project outputs and outcomes, that are not needed uniquely to create (for physical/software/data product) or deliver (for a service) just a single element from questions 1 and 2?

One answer to this last question is always “Project Management”

4. What products, if any, internal to the project, that involve project cost or other resources in their realization, are necessary to deliver the project outputs and outcomes, that are not needed uniquely to create (for a physical/software/data product) or deliver (for a service) just a single element from questions 1, 2 and 3?

To define sub-elements below level 2, the questions for a product element are:

- 5-1. What products are to be integrated to create this product element?
- 5-2. In addition to the products from question 5-1, what services are to be performed to create this product element, that are not needed uniquely to create just a single sub-element from question 5-1?
- 5-3. In addition to the products and services from questions 5-1 and 5-2 respectively, what products are necessary, that involve project cost or other resources in their realization, to create this product element, that are not needed uniquely to create (for physical/software/data product) or perform (for a service) just a single sub-element from questions 5-1 and 5-2 respectively?

To define sub-elements below level 2, the questions for a service element are:

- 6-1. What services are to be integrated to perform this service element?
- 6-2. In addition to the services from question 6-1, what products are necessary to perform this service element, that involve project cost or other resources in their realization, and that are not needed uniquely to perform just a single service sub-element from question 6-1?

Development Logic for Project (Work) Breakdown Structure – PBS (WBS) Project which has just one deliverable, a product

Example project: the bicycle project in the PMI Practice Standard for Work Breakdown Structures Second Edition.

The level 1 element is the project.

To define level 2 elements:

1. What products are to be integrated to create this sole deliverable product?
2. In addition to the products from question 1, what services are to be performed to create the sole deliverable product, that are not needed uniquely to create just a single element from question 1?
3. In addition to the products and services from questions 1 and 2 respectively, what products are necessary, that involve project cost or other resources in their realization, to create the sole deliverable product, that are not needed uniquely to create (for physical/software/data product) or perform (for a service) just a single element from questions 1 and 2 respectively?

To define sub-elements below level 2, the questions for a product element are:

- 4-1. What products are to be integrated to create this product element?
- 4-2. In addition to the products from question 4-1, what services are to be performed to create this product element, that are not needed uniquely to create just a single sub-element from question 4-1?
- 4-3. In addition to the products and services from questions 4-1 and 4-2 respectively, what products are necessary, that involve project cost or other resources in their realization, to create this product element, that are not needed uniquely to create (for physical/software/data product) or perform (for a service) just a single sub-element from questions 4-1 and 4-2 respectively?

To define sub-elements below level 2, the questions for a service element are:

- 5-1. What services are to be integrated to perform this service element?
- 5-2. In addition to the services from question 5-1, what products are necessary to perform this service element, that involve project cost or other resources in their realization, and that are not needed uniquely to perform just a single service sub-element from question 5-1?

Development Logic for Project (Work) Breakdown Structure – PBS (WBS) Project which has just one deliverable, a service

The level 1 element is the project.

To define level 2 elements:

1. What services are to be integrated to deliver this sole deliverable service?
2. In addition to the services from question 1, what products are necessary, that involve project cost or other resources in their realization, to perform this sole deliverable service, that are not needed uniquely to perform just a single service element from question 1?

To define sub-elements below level 2, the questions for a product element are:

- 3-1. What products are to be integrated to create this product element?
- 3-2. In addition to the products from question 3-1, what services are to be performed to create this product element, that are not needed uniquely to create just a single sub-element from question 3-1?
- 3-3. In addition to the products and services from questions 3-1 and 3-2 respectively, what products are necessary, that involve project cost or other resources in their realization, to create this product element, that are not needed uniquely to create (for physical/software/data product) or perform (for a service) just a single sub-element from questions 3-1 and 3-2 respectively?

To define sub-elements below level 2, the questions for a service element are:

- 4-1. What services are to be integrated to perform this service element?
- 4-2. In addition to the services from question 4-1, what products are necessary to perform this service element, that involve project cost or other resources in their realization, and that are not needed uniquely to perform just a single service sub-element from question 4-1?

Development Logic for Project (Work) Breakdown Structure – PBS (WBS)

Departures from the preceding steps

There are a few qualifications to the steps above for developing a great WBS under the circumstances below:

- strict adherence would result in PBS/WBS elements that are too small to be cost-effective, e.g. many data items;
- work is highly interactive, spanning many levels and elements of the PBS/WBS, e.g. project management;
- the project is long and has clearly defined stages or phases, each with well defined deliverables; and
- the project involves work performed repetitively, and very little integration is required between the products of that work to form the end product, e.g. a project to detail a fleet of 500 cars.

WBS Standard: MIL-STD-881B

MIL-STD-881B
25 March 1993

SUPERSEDING
MIL-STD-881A
25 April 1975

MILITARY STANDARD
WORK BREAKDOWN STRUCTURES
FOR
DEFENSE MATERIEL ITEMS



WBS Standard: MIL-STD-881B Strengths and Weaknesses

- **Strengths**

- The principles espoused are OK, with qualifications.
- Individual service element scope descriptions are generally comprehensive, realistic and provide a useful starting point for tailoring the relevant ones to a specific project.

- **Weaknesses**

- The use of template WBS for systems of various types does not work in an engineering sense (designed for counting beans, not effectively managing the development of complex systems). Extremely damaging to projects!
- MIL-STD-881B breaks its own rules with the WBS templates!
- The support system is not presented as a WBS element in its own right (it should be).

- **Conclusion**

- Thank goodness it has been cancelled!

WBS Standard: MIL-STD-881C

**NOT MEASUREMENT
SENSITIVE**

**MIL-STD-881C
3 October 2011**

**SUPERSEDING
MIL-HDBK-881A
30 July 2005
MIL-STD-881B
25 March 1993**

**DEPARTMENT OF DEFENSE
STANDARD PRACTICE**

**WORK BREAKDOWN STRUCTURES
FOR DEFENSE MATERIEL ITEMS**

WBS Standard: MIL-STD-881C Strengths and Weaknesses

- **Strengths**

- MIL-STD-881C is something of an improvement on MIL-STD-881B (which was terrible)

- **Weaknesses**

- Weak in capturing the essential meaning of product orientation.
- The principles espoused are variable; some are inappropriate
- The use of template WBS for systems of various types does not work in a project management and engineering sense (designed for counting beans, not effectively managing the development of complex systems). Damaging to projects!
- MIL-STD-881C breaks its own rules with the WBS templates!

- **Conclusion**

- As a recent standard, MIL-STD-881C represents an opportunity lost.

WBS Standard: DEF (AUST) 5664A



COMMONWEALTH OF AUSTRALIA

AUSTRALIAN DEFENCE STANDARD

DEF(AUST)5664 Issue A

Dated April 2005

REPLACING/SUPERSEDING

DEF(AUST)5664

Dated Aug 1995

**WORK BREAKDOWN STRUCTURES FOR
DEFENCE MATERIEL PROJECTS**

WBS Standard: DEF (AUST) 5664A Strengths and Weaknesses

- **Strengths**

- The principles espoused are excellent.
- Individual element scope descriptions are generally well-founded.

- **Weaknesses**

- The model top level Work Breakdown Structure is deficient, in that a two-subsystem architecture of Mission System and Support System is an inefficient way of engineering a capability.
- There are other, minor peculiarities.

- **Conclusion**

- Always use DEF (AUST) 5664A in preference to MIL-STD-881.
- Don't adopt the Mission System/Support System architecture at level 2.

PMI Practice Standard for Work Breakdown Structures (Second Edition)

Project Management Institute

Practice Standard for Work Breakdown Structures Second Edition

Note: This slide is for PMI use only

PMI Practice Standard for Work Breakdown Structures (Second Edition): strengths and weaknesses

- **Strengths**

- Provides a good overview of the use of WBS.
- Well organized and written.

- **Weaknesses**

- Fails to capture the essential meaning of product orientation. Product orientation is a non-negotiable attribute for a WBS to be fit for its intended use.
- The generic example throughout the guide (the bicycle) is poor.
- The use as an example of a project with only one deliverable is unfortunate.
- The example WBSs in the Annexes are generally poor examples, mainly because of functional, not product orientation.

- **Conclusion**

- The PMI Practice Standard for Work Breakdown Structures, Second Edition, provides useful background, but should be avoided as a primary reference for producing good WBS.

PMI Practice Standard for Work Breakdown Structures (Second Edition): existing figure 2-1

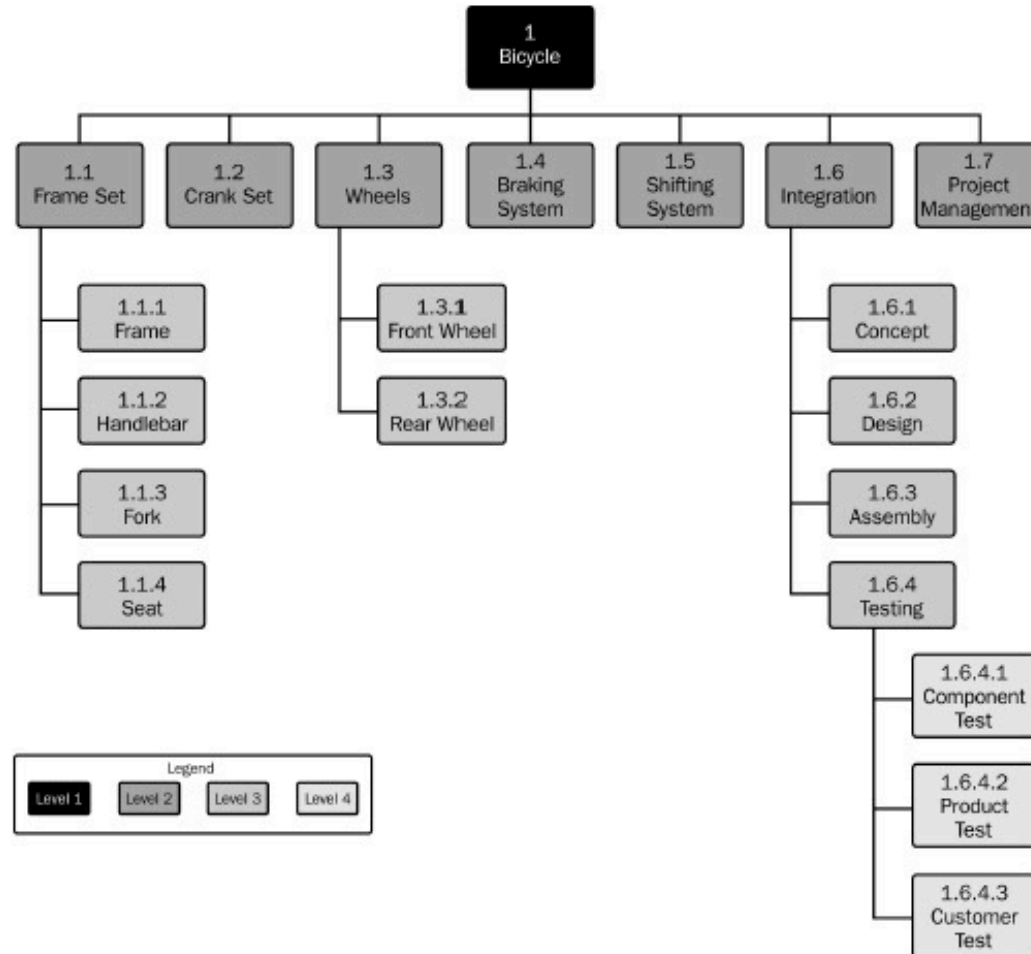
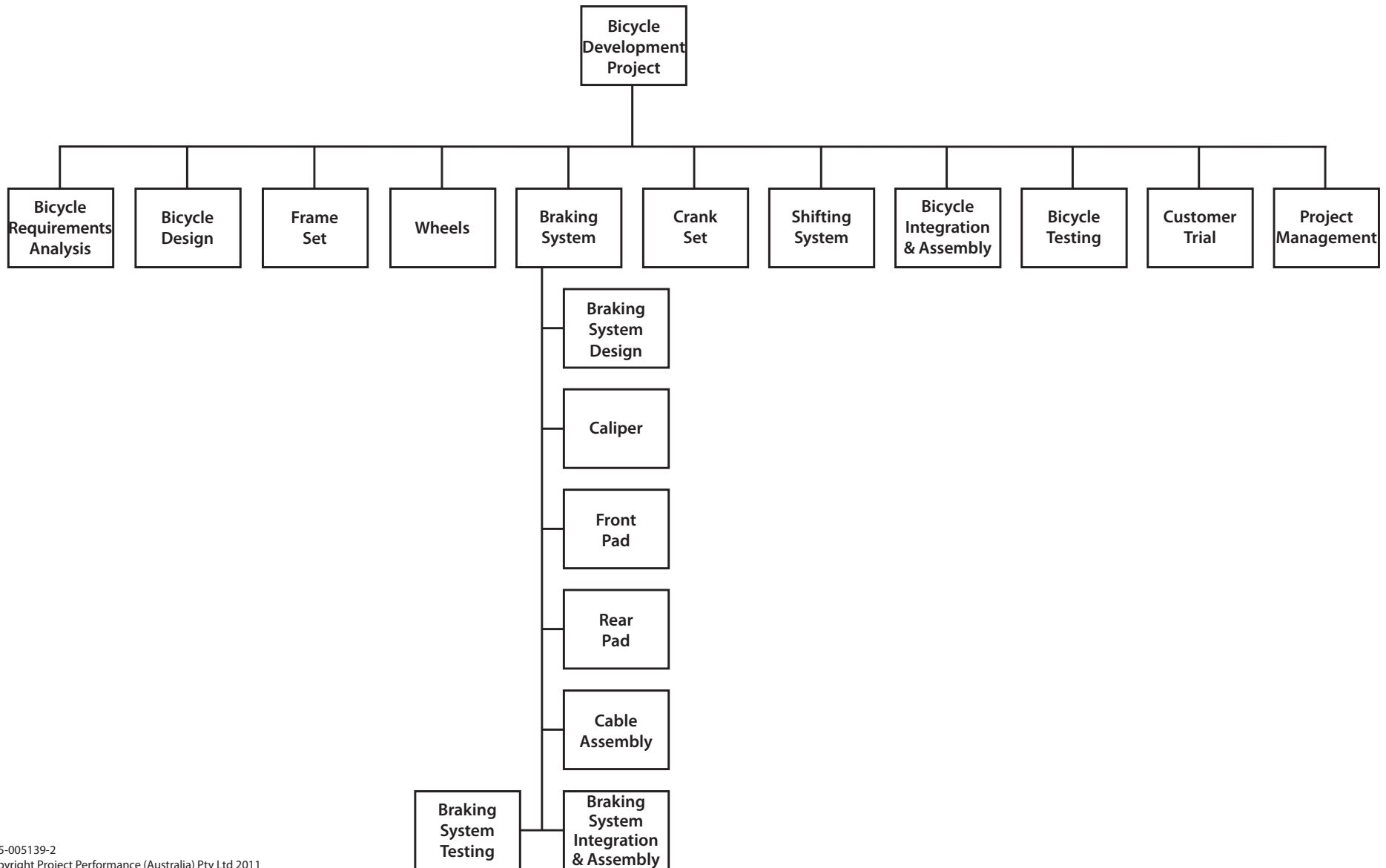


Figure 2-1. WBS Bicycle Example

Note: This slide is for PMI use only

PMI Practice Standard for Work Breakdown Structures (Second Edition): replacement figure 2-1



Product Breakdown Structure - Embedded within PBS/WBS

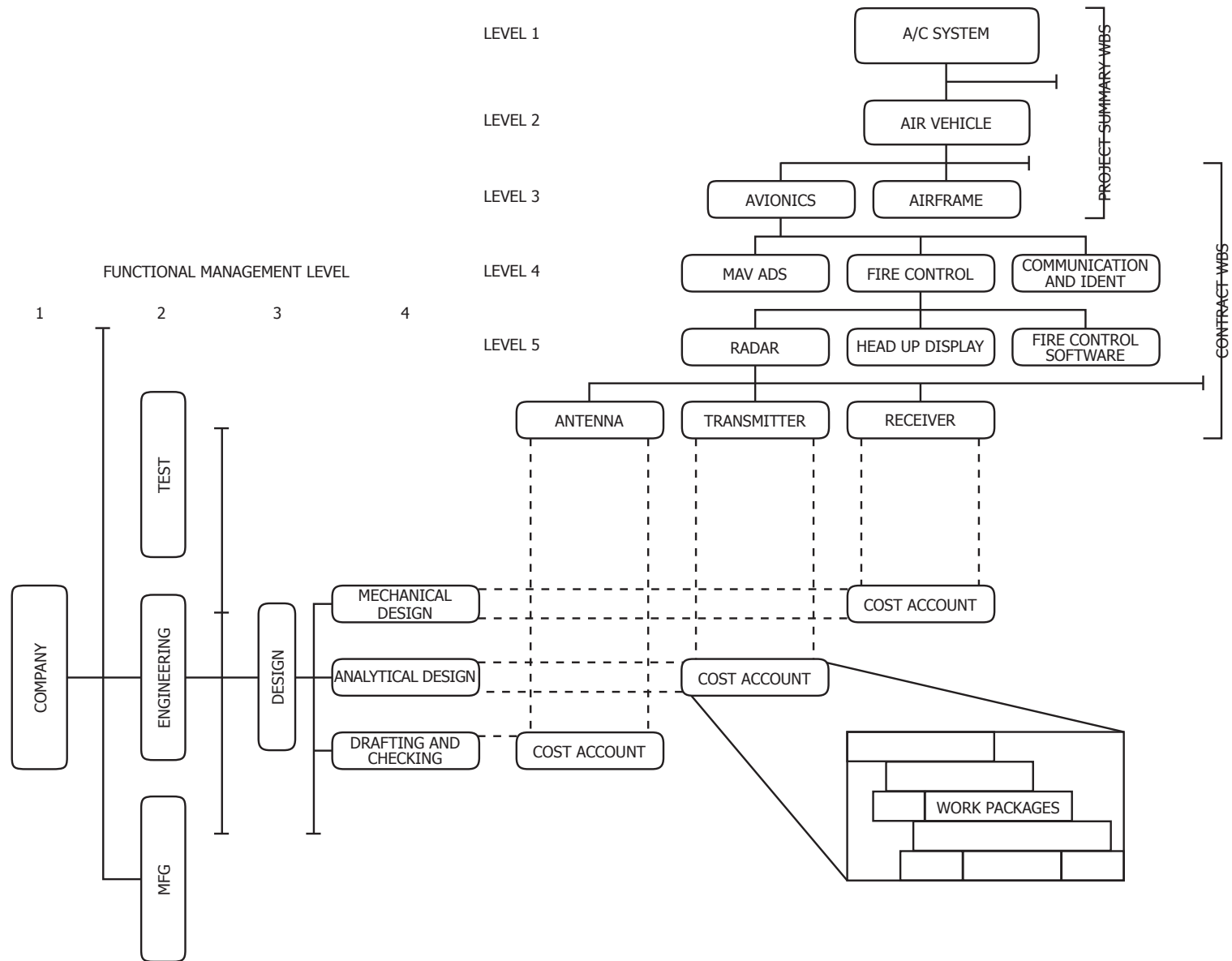
- A work product of system architecting
- Systems engineering activity performed with respect to each deliverable produces, for that deliverable:
 - Physical architecture, incorporating System Breakdown Structure
 - Specification Tree
- Specification Tree mirrors Product Breakdown Structure except for the inclusion of Interface Requirements Specifications (IRSs) and Interface Design Descriptions (IDDs)

Note: The term System Breakdown refers to the structure containing solution elements, whether or not they are produced, whereas the term Product Breakdown Structure is limited to produced elements. So, for example, the atmosphere could appear in a System Breakdown Structure, but not in a Product Breakdown Structure.

PBS/WBS and IPTs related

- An Integrated Product Team (IPT) is a multi-disciplinary team tasked and empowered to take a product from requirements to delivery. It has stakeholder participation, and works on a consensus basis of decision-making.
- Integrated Product Team (IPT) structure and PBS/WBS should be closely related, down to the level(s) below which IPTs are not used.
- More than one smaller PBS/WBS element may be assigned to a given IPT in the interests of efficiency, but as multiple elements of progressively smaller size are assigned, the benefits of an IPT approach are diminished and eventually lost.

PBS/WBS - Functional Integration



Further hints regarding PBS/WBS

- If a functional activity (service) can be identified with a product element, make it a part of that product element.
- Define in the PBS/WBS Dictionary the scope and nature of each product element, not its standards.
- Review all source documentation to ensure that every item of a Statement of Work (SOW) nature has been explicitly accommodated in the PBS/WBS. Build a verification matrix for traceability purposes.
- Maintain correspondence between contracted/subcontracted activities and PBS/WBS element definitions.
- Use multiple PBS/WBS elements per contract/subcontract to minimize contract overhead costs and facilitate enforcement of relationships between deliverables.
- Remember that the PBS/WBS is a management tool, not a specification. Don't use excessive detail – a paragraph or two describing each element is usually adequate.
- Avoid including cost, schedule and resourcing information in the PBS/WBS Dictionary itself – these should be confined to the various plans, often by reference.
- Accept a faulty PBS/WBS from the customer only if you have to - the cost of living with a faulty PBS/WBS can be very great indeed.
- Keep lowest level elements small enough to be understood and managed by one person and large enough to justify the overhead associated with a PBS/WBS element.
- Regard the PBS/WBS as a crucial, living entity from project commencement to completion of the project.

Summary of PBS/WBS

- The PBS/WBS is a framework for definition and control during the conduct of a project of product quality, cost and schedule.
- IPTs if used are defined to closely align with the elements of the PBS/WBS.
- The PBS/WBS *must* be product-oriented.
- The PBS/WBS consists of an Index and Dictionary - construct both.
- The PBS/WBS for any project should be developed from first principles, reflecting how the project is to be executed.

May you delight yourself and your stakeholders with your project outcomes!

Thank you for your interest 😊

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