



APM / INCOSE UK Systems Thinking Specific Interest Group

Fusion Point Guidance – Product Based Planning

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1. Who Is This Guidance For

This guide is primarily aimed at Project Managers and Project Support (Project Management Office) staff who are tasked with generating management plans and schedules, as well as Systems Engineering staff who have the skills and information necessary to provide a robust foundation for these plans.

This guide will also provide useful information about the benefits of SE and PM to project sponsors in terms of how their project will be executed, and to other PM and SE professionals who work in projects to understand why activities are being carried out in a certain way.

Target Audience:

Planners and Systems Engineers to jointly undertake the PBS, WBS, OBS and CBS and Schedule definitions, and Project Managers to enable and encourage joint working.

2. What Is Product Based Planning

Product-Based Planning is a technique described in the PRINCE2®¹ framework [Reference 1] which becomes much more powerful when integrated with the Systems Engineering techniques used to develop the Product Breakdown Structure (PBS) and Work Breakdown Structure (WBS). This guidance extends this to include Cost Breakdown Structure (CBS) and Organisation Breakdown Structure (OBS) and ensure these are aligned with the SE System Requirements and Technical Architecture products.

Product-based planning in PRINCE2®

PRINCE2® describes Product-Based Planning as

“A four-step technique leading to a comprehensive plan based on creation and delivery of required outputs. The technique considers prerequisite products, quality requirements and the dependencies between products.”

Figure 1 shows an extract from the PRINCE2® framework highlighting key steps and inputs in setting up and executing Product-Based Planning (PBP). Inputs include the **Project Approach** - a high level description of the strategic direction or constraints for a project, determined when setting up a project (such as deciding to 'buy off-the-shelf'). Expectations, assurance and final acceptance criteria (amongst others) then have to be defined in a **Quality Plan**.

The PRINCE2® technique then creates four key items – a **Product Description** of the final output, a **Product Breakdown Structure** (PBS) of the elements that make up that final output, **Product Descriptions** of the individual elements in the PBS (including quality requirements, applied standards etc.), and a **Product Flow Diagram** which shows the order in which the elements are created and the dependencies between them.

¹ PRINCE2 is a Registered Trademark of Axelos Ltd. Further information can be found at <https://www.axelos.com/best-practice-solutions/prince2>

This document represents the thoughts and conclusions of the Systems Thinking SIG and not necessarily the views of the APM or INCOSE UK. It is intended to assist Project, Programme and Portfolio Management and Systems Engineering practitioners wishing to explore concepts and ideas around Systems Thinking in P3M and to stimulate discussion on the subject. Feedback on the contents of this paper should be sent to the Systems Thinking SIG (SystemsThinkingSIG@apm.org.uk). It therefore does not constitute any formal position (or liability arising) on the part of the International Council for Systems Engineering (INCOSE), INCOSE UK Ltd. or the Association for Project Management (APM), nor should any formal endorsement by these bodies be inferred.

Note that the technique includes *Management Products* (Business Case, Controls, Quality Plans etc.) as well as any system output items or information – these are referred to as *Specialist Products* in PRINCE2®.

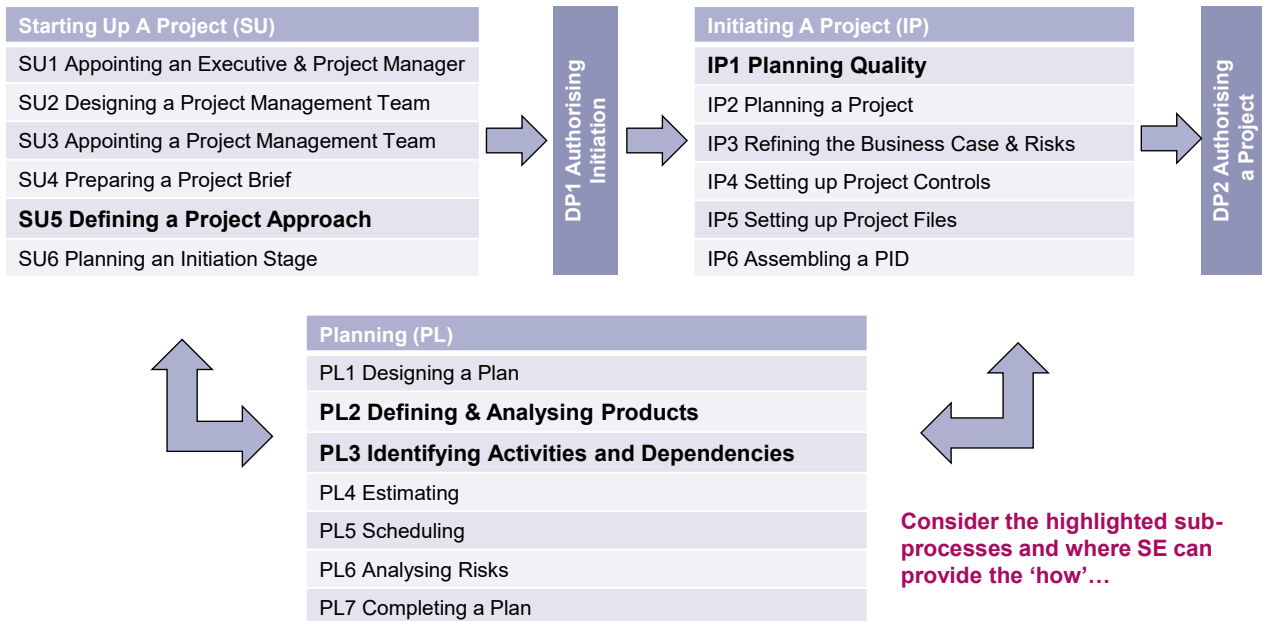


Figure 1: Key steps in PRINCE2® Product Based Planning - sub-processes in Starting up a Project, Initiating a Project and Planning

Defining the work

A PBS is a hierarchical decomposition of the products that the project is required to generate in order to develop the proposed solution. Collectively, the lowest level in each branch defines all of the hardware, software, information items and management products that will make up the realised system.

This is then translated into the activity-orientated Product Flow Diagram (PFD) or a Work Breakdown Structure (WBS)² which identifies the work that needs to be done to generate each product plus any additional 'integration' activities that are needed to combine products generated at the level below in the hierarchy. Irrespective of the specific method employed (PFD or WBS), the description is accompanied by definitions of the steps (i.e. Product Descriptions or a WBS Dictionary) that clearly define the scope of each element and its outputs.

The WBS or PFD is then used to generate a Project Schedule – the model of the various activities set against a timeline, which captures the dependencies and attaches the resources required (and documented through the Organisation Breakdown Structure (OBS)) to generate each product and achieve the project goals. The Project Schedule should also contain any Risk Mitigation activities together with their associated costs) and other management activities that are planned, and the key milestones and review points. . Using the resourcing of WBS or PFD activities, the Project Budget and Spend Profile is developed from the cost estimates for each of the activities.

3. Why Is Product Based Planning Important

The Product Based Planning technique provides a structured comprehensive approach to the planning of project activities³, avoiding gaps in outputs, creating and communicating a robust understanding of the scale and contents of the challenge being undertaken. Planning activities can be iterative in nature, especially where the detail of the final outputs is not clear at the outset, as shown in Figure 2, and a disciplined approach is therefore important.

² A PFD describes the flow or activity network required to generate the required products, a WBS is typically a hierarchical structure (like a PBS) that captures all the tasks (but not necessarily the sequence in which they are done).

³ The principles of Product Based Planning can also be extended in concept to programme planning although this requires switching from products to benefits and outcomes.

Product based planning can also be extended into an Agile environment [see Reference 2] - whilst the products may be flexible in their definition in this environment, a firm foundation and discipline is still needed to provide for a convergent solution.

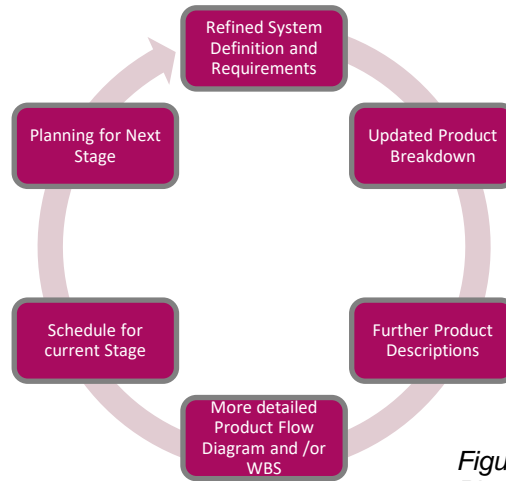


Figure 2: The iterative nature of Integrated Planning

4. Where are the Issues

Where a gap exists between SE and PM disciplines, as shown in Figure 3, Project Management practitioners may be undertaking definition of product breakdowns without a full understanding of the system elements. PRINCE2® does not provide any guidance or instruction on the formation of the specialist elements of the Product Breakdown Structure. Duplicate and missing effort may occur as the PM practitioners create a system model (that may be incomplete) and SE practitioners focus on the product system and not include the change delivery system (for example not including the management products).

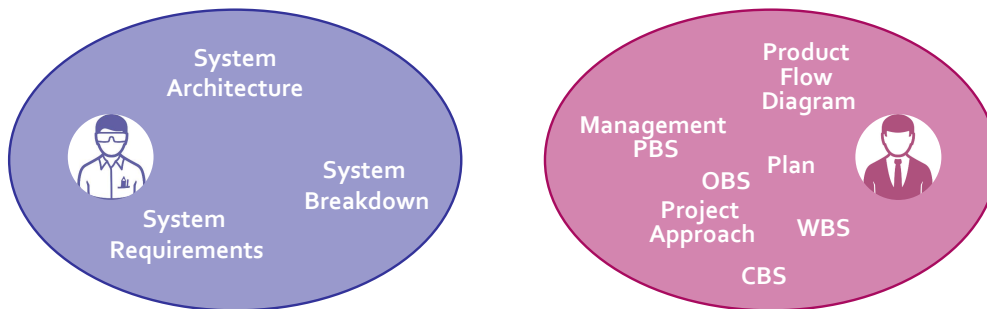


Figure 3: Where a planning **gap** exists between PM and SE practitioners

Figure 4 illustrates an improved situation where a combined PBS is created, but no added value is occurring.

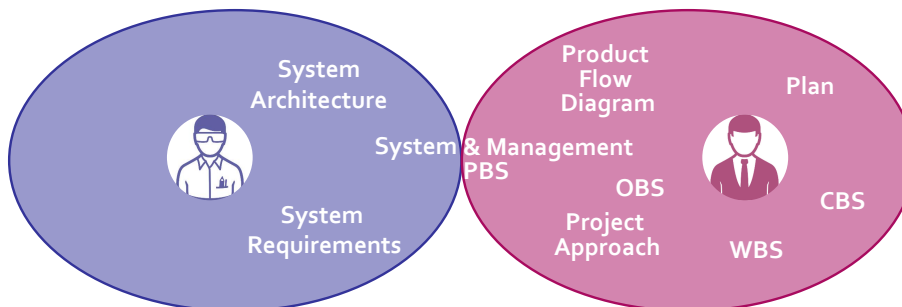


Figure 4: The disciplines recognise the PBS **touchpoint** but the value of integrated working is not yet realised

5. How Can A Fusion Between SE & PM Help

Using SE techniques

Before a PBS can be generated, much Systems Engineering activity may need to be undertaken, as indicated by the questions posed in

Figure 5 where the SE activities can provide an answer (the questions are taken from the PRINCE2® manual). In particular, a clear and common understanding of the customer requirements must be established and documented, different candidate solutions may have to be developed followed by evaluation and down selection to a single proposed solution. These activities map to the Concept Stage of the Systems Engineering lifecycle, reinforcing the fact that the Systems Engineering activities required to generate the PBS must themselves be incorporated into the Project Schedule. The Project Schedule is likely to evolve as a result of these Systems Engineering activities.

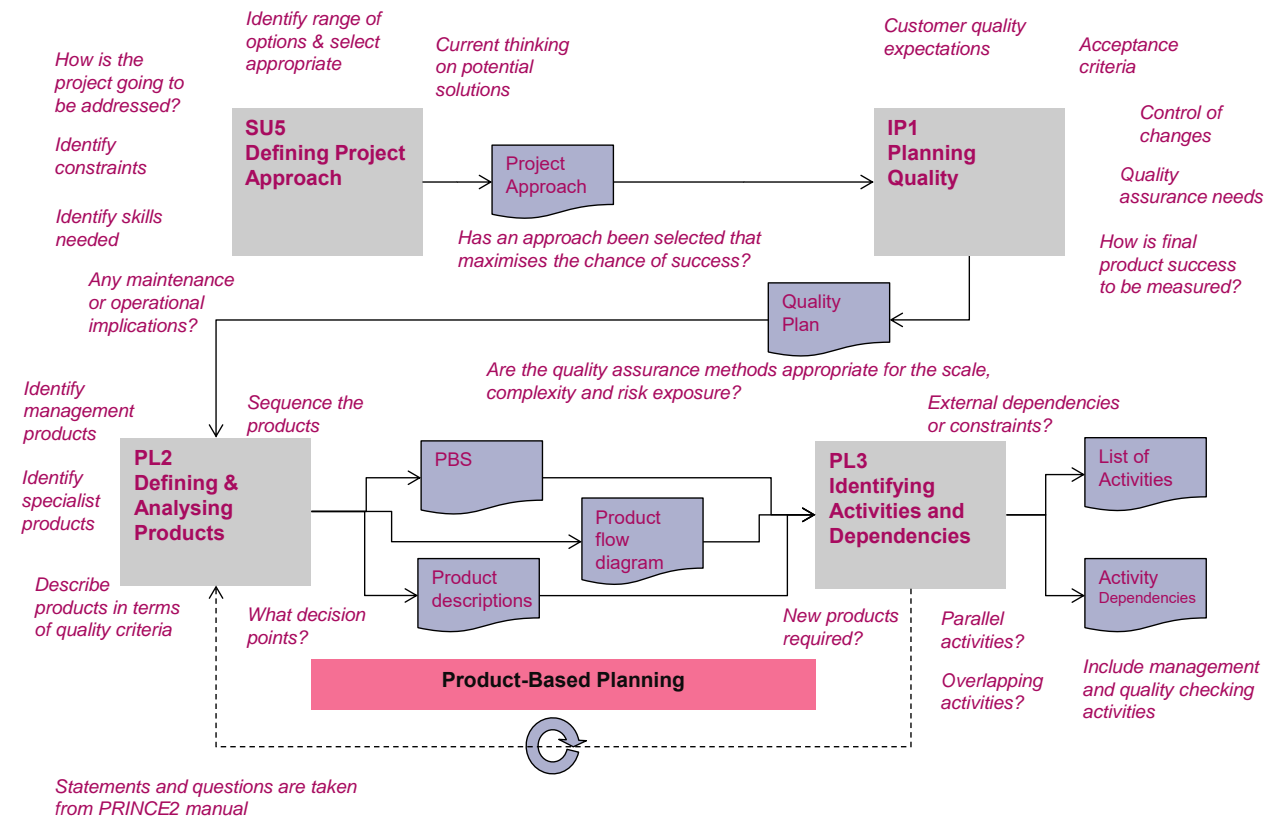


Figure 5: Questions from PRINCE2® processes where SE could provide the answer

Where the two disciplines are working together, as in Figure 6 or integrated, as in Figure 7, then value can be generated from an improved understanding of not only **what** has to be created and **why**, but the optimum approach to **how** (and ultimately, **when**) it should be created and aligned with how much this will cost.

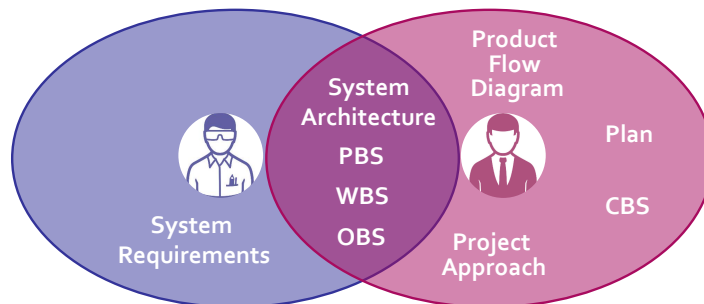


Figure 6: The two disciplines **overlap** in understanding and undertaking elements of the planning process

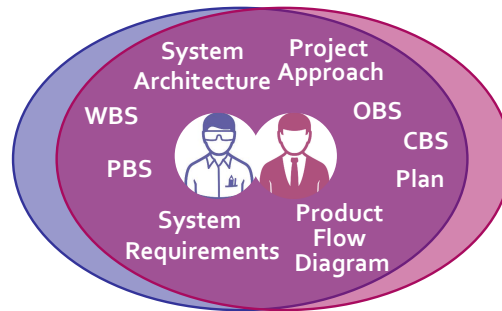


Figure 7: An integrated combined approach to planning obtains maximum value from both disciplines

6. When Can A Fusion Between SE & PM Help

A joint iterative process through the life cycle

Even at the end of a Concept Phase⁴, (Starting Up A Project in PRINCE2® terms), the PBS may still be subject to change as further design work is undertaken during a Definition (or Development) Phase (Initiating A Project and/or Managing A Stage Boundary in PRINCE2® terms). More generally, it should be appreciated that Integrated Planning is an iterative process as shown previously in Figure 2. As the project progresses and the System Design matures, then the PBS and the corresponding WBS and Project Schedule must also evolve and mature as further detail on future activities is introduced (e.g. through PRINCE2 Project Stages or following a rolling wave planning approach). Thus the overlap between SE and PM continues through the Project life cycle.

Note that whilst the PBS is typically owned by the Systems Engineering function and the Project Schedule and Project Spend Profile are owned by the Project Management function, the PBF and/or WBS should be jointly owned and thus form one of the key overlaps between the Project Management and Systems Engineering functions within an Integrated Project Team.

By fusing Project Management and System Engineering such that an aligned set of definition structures (Requirement, Architecture, PBS, PFD, WBS, OBS, CBS) is jointly developed during Project Planning, the following benefits can be realised:

- Common understanding between PM and SE of the project: its scope, content, approach and challenges.
- Aligned PM and SE management information within the project and aligned project reporting to organisation management from PM and SE (which may operate different reporting chains).
- Projects often apply 'best practice' PM techniques (eg Earned Value Management (EVM) to give Cost and Schedule At Completion estimates) following Project Planning. The approach described above develops the information necessary to operate EVM as part of the planning process.
- More comprehensive Risk Management for both Technical and Non-Technical categories agreed and understood across the PM and SE communities and integrated with the Project Plan.
- Better project Configuration and Change Management as a result of the ability to establish project-wide 'Project Baselines' and use these to coherently assess the impact of proposed Changes on both the technical and non-technical project elements.

7. References

- [1] PRINCE2 manual 2009 (Managing Successful Project With PRINCE2, AXELOS, 2009, ISBN 9780113310583)
- [2] Agile project management: Integrating DSDM into an existing PRINCE2 environment, K. Richards, January 2013 (available at <https://www.axelos.com/case-studies-and-white-papers/integrating-dsdm-into-prince2-environment>)

⁴ For definition of the Phases, refer to APM Body of Knowledge (<http://knowledge.apm.org.uk/bok/life-cycle>)