The Engineering and Manufacture of Software-based Products

Grady H Campbell Jr
Prosperity Heights Software LLC
Annandale, VA, USA
gradycampbell@domain-specific.com

Abstract

The practices of software development are facing potentially dramatic change. A product line approach will remain relevant by accommodating emerging techniques, such as the capabilities of generative AI (artificial intelligence). This tutorial surveys the content of a draft book [1] that presents such an approach, built on the concept of a product family, for the systematic development of software-based products.

A product family is defined in terms of the perceived similarity (commonalities and variabilities) in behavior of an envisioned set of products. These products are seen to differ according to a set of customer-relevant deferred decisions that determine why multiple products may be needed and how each such product is to be built. Partial resolution of these decisions reduces a family to a subfamily whereas full resolution designates a particular instance of the family.

The presented approach adopts an objective of *producibility*—the ability to deliver needed capabilities to customers in a timely, cost-effective, and predictable manner—in building either singular evolving software products or an evolving domain with which customized software-based products targeting a coherent market can then be derived. The former option defines a software engineering formulation for building a product, expressed in the form of a notional product model. This then provides a foundation for the latter option toward building and instantiating a product family. This option is further extended to more directly address the relevance of enterprise and program management, systems and hardware engineering, and customer engagement. This approach retains the tripartite concept introduced in 1998 with the Domain-specific Engineering (DsE) methodology. DsE was a refinement and reformulation of the Synthesis methodology conceived in 1990 at the Software Productivity Consortium as the first comprehensive approach to software development based on the product family concept. DsE continues to be method-agnostic, accommodating diversity and innovation in software methods and practices, including the potential uses of generative AI.

DsE is distinguished in part by the conception of application engineering as a streamlined model-based product manufacturing process. This process entails the resolution of domain-specified deferred decisions, associated with a concrete realization of a product family, as a sufficient means for deriving, comparatively evaluating, and delivering alternative customized whole products.

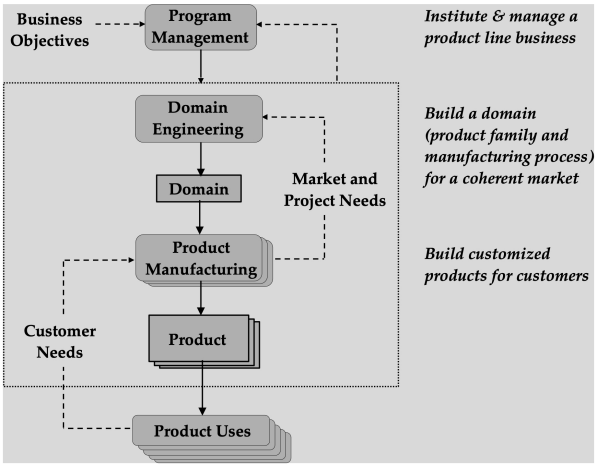

Figure 1: The DsE Tripartite Process

CCS Concepts

• Software and its engineering; **• Software organization and properties; Software creation and management**; **• (Software development process management, Software development techniques, Software post-development issues)**;

Keywords

Methodology, Similarity, Singular Product, Product Family

ACM Reference Format:
Grady H Campbell Jr. 2025. The Engineering and Manufacture of Software-based Products. In *29th ACM International Systems and Software Product Line Conference - Volume A (SPLC-A '25), September 01–05, 2025, A Coruña, Spain.* ACM, New York, NY, USA, 1 page. https://doi.org/10.1145/3744915.3749148

References

[1] G. Campbell, *The Engineering and Manufacture of Software-based Products* (draft), Prosperity Heights Software LLC, Annandale, Va. 2025. <www.domain-specific.com/EMSP>
[2] E. W. Dijkstra, "Notes on Structured Programming: On Program Families", *Structured Programming*, Academic Press, London, 1972, pp. 39-41 (based on Dijkstra manuscript #249, Apr 1970, pp. 50-52).
[3] N. Dershowitz, "Program Abstraction and Instantiation", *ACM Trans. Program. Lang. Syst.*, 7, 3 (July 1985), pp. 446-477.
[4] D. Parnas and P. Clements, "A Rational Design Process: How and Why to Fake It", *IEEE Transactions on Software Engineering*, Vol. SE-12, No. 2, February 1986, pp. 251-257.
[5] M. Ezran, M. Morisio, and C. Tully, "Diversity in Reuse Processes", *IEEE Software* 17, 4 (July/Aug 2000), pp. 56-63.

SPLC-A '25, A Coruña, Spain

ACM ISBN 979-8-4007-2024-6/2025/09
https://doi.org/10.1145/3744915.3749148