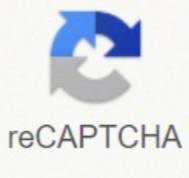
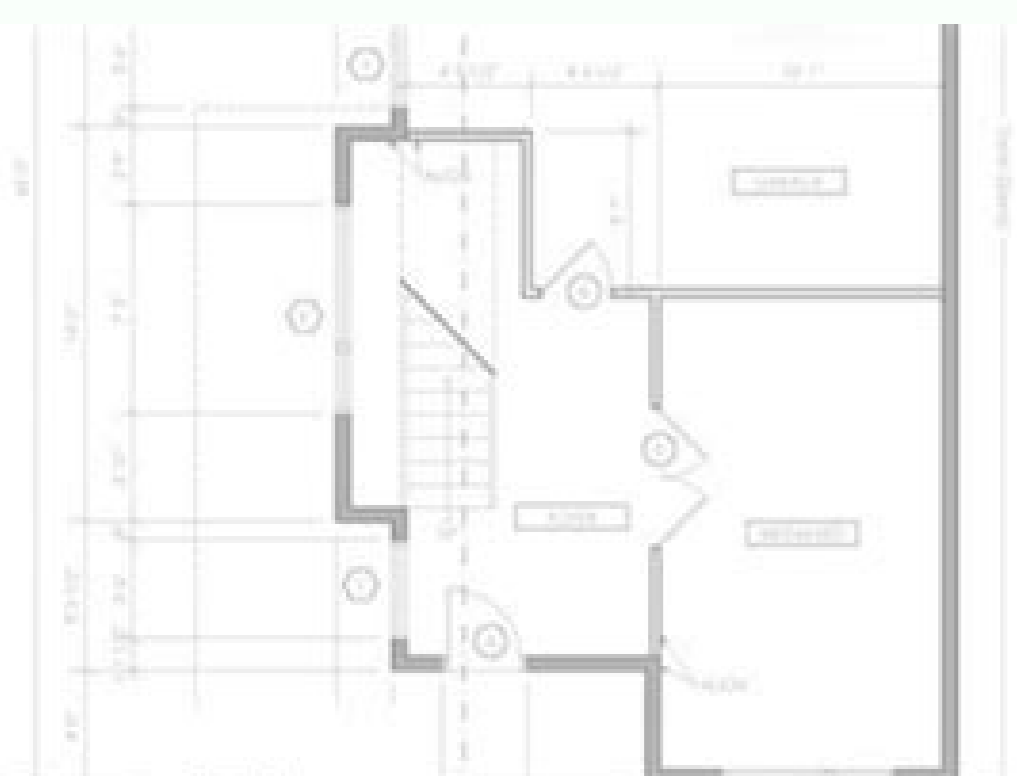




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Michael Brightman

# The SketchUp Workflow for Architecture

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Visualizing Design,  
and Creating  
Construction Documents  
with SketchUp Pro  
and LayOut



Currently working on a book entitled *Workflow for Software Design, Architecture and Development*. It is a book on software design architecture and development. It covers the entire process from the initial idea to the final product. It is a book on software design architecture and development. It covers the entire process from the initial idea to the final product.

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## The Notion of Variability in Software Architecture – Results from a Preliminary Exploratory Study

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### ABSTRACT

**Context:** In the software product line domain, the concept of variability is well recognized. However, variability in the context of software architecture still seems to be poorly understood. **Objective:** In this paper, we aim at contributing to the development of a basic understanding of the notion of variability in the software architecture domain, beyond the idea of product lines. **Method:** We perform a preliminary exploratory study which consists of two parts: an expert survey among 11 subjects, and a mini focus group with 4 participants. For both parts, we collect and analyze mostly qualitative data. **Results:** Our observations indicate that there seems to be no common understanding of “variability” in the context of software architecture. On the other hand, some challenges related to variability in software architecture are similar to challenges identified in the product line domain. **Conclusions:** Variability in software architecture might require more theoretical foundations in order to establish “variability” as an architectural key concept and first-class quality attribute.

### Categories and Subject Descriptors

D.2.10 [Software Engineering]: Design – methodologies, representation; D.2.11 [Software Engineering]: Software Architectures – data abstraction, languages; K.6.3 [Management of Computing and Information Systems]: Software Management – software development

### General Terms

Management, Documentation, Design, Theory.

### Keywords

Software architecture, variability, product lines, questionnaire, mini focus group.

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### 1. INTRODUCTION

#### 1.1 Problem Statement and Related Work

Supporting variability in software systems is essential to manage commonalities and differences across software, and to accommodate software reuse in different organizations and product versions. Systematically identifying and appropriately managing variability among different systems distinguishes variability from other approaches that support reuse [7]. The main cause for variability is the delay of design decisions to the latest point that is economically feasible. Examples of mechanisms to accommodate variability include software product lines, configuration wizards and tools in commercial software, configuration interfaces of software components in component-based software engineering, or the dynamic runtime composition of web services [29].

So far, variability has primarily been studied in the software product line domain [7–10]. In general, variability in the product line domain is understood as the ability of an (software) artifact to be configured, customized, extended, or changed for a specific context, in a preplanned manner [3]. Moreover, most definitions of variability in the product line domain include the concepts of “variation point”, “variant” and “core asset” [7, 11]. This means, variability is often understood as “anticipated” change, i.e., change that is mostly foreseen, with predefined points of potential change and adaptation, as well as options for how to adapt software systems. In addition, there is evolution of variability which might not necessarily be anticipated.

The product line community also introduced the notion of “product line architecture” [1]. The product line architecture describes concepts and structures to achieve variation in features of different products, while sharing as many parts as possible in the implementation [17]. Thus, the product line architecture captures the central design of all products of the product line, including variability and commonalities of several product instances [30].

However, compared to traditional software architecture [14] (please note that we use singular when referring to the discipline of “software architecture”), product line architectures have a reduced scope with regard to variability. First, product line architectures address variability explicitly and have a limited focus by emphasizing “features”, “variation points”, “variants”, etc. This means, in product lines, variability is captured in features and decisions. On the other hand, variability in the context of



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