

CS415 – Software Product Line Engineering – Homework 1

1. What is the difference between first-generation PLE and second-generation PLE according to the reading?

	1st Generation PLE	2nd Generation PLE
Language	Language is limited with the product line's domain and discriminate products from each other (4)	Reliance on features as the lingua franca to express product differences in all phases of the lifecycle (5)
Placing Artifacts	Counts non-software artifacts as core asset by seeing the principal core asset as software (4)	See the all artifacts at the same value throughout to all engineering lifecycle (7)
Configuration Management	See CM as an important aspect of PLE but without a distinction between core asset CM and product CM (4)	There is a strong distinction between core asset CM and product CM, and CM just maintains assets. It does not deal with the product (8)
Way of Production	There is a distinction between domain engineering and application engineering. Application engineering is about creating any assets used in a single product (4)	Includes a hierarchical product lines and cooperative feature model development (5)

2. What is the term “lingua franca” refer to? Why it is important for Software Product Line Engineering?

Lingua franca is a sort of common language which makes the terms and features understandable for the all stakeholders of the product and provides transitivity between different domains. For example when an employer mentions about a feature which is included in lingua franca, then all contributors of lifecycle should understand the topic. It is important for SPLE because there can be several employers which are interested in for different domains in product line and stating the product differences material by material cannot be comprehensible for some of the stakeholders. So describing features as the lingua franca will increase the understandability and will help to describe large and complex product lines in an easier manner (5).

3. Why General Motors engineers have developed a product line instead of single-system development or software reuse? What are the advancements of using SPLE?

Today they are not but in 2011 General Motors was the largest automotive manufacturer in the world by selling over 9 millions of vehicles (11). A company should have an efficient, rapid and smooth production approach for being able to produce this amount of car in a year. So there is a need of organized product line instead of a single system development for meeting the demand and maintaining supply with wide range of variety and latest technology systems. There are sub reasons which can explain the product line need of GM. First of all a vehicle has a very complex engineered subsystems which are more than 300 (12). Single system development would prevent the variety for a this sort of complexity. GM presents huge amount of variations to customers (12) and supplying variation is a key point for a product line. A vehicle has components from different domains (12) and to handle the collaborative work of these different components, product line must be settled. If you are producing about 9 millions of vehicle in a year, traceability and consistency become very important for the sustainability of the smooth production. A product line increases the traceability of a product lifecycle. About 5000 engineers are working in the production process in GM (12), so it would not be efficient and applicable to have single system development for having ability to organize the work of huge of contributors. Also software reuse is not applicable because the production management should be done by considering current and future model years. Change in

the industry is very fast and GM has to feed the customers by new features and latest technology for every year. To sum up all these facts and inferences, it is impossible for GM to sustain their production without a product line and software reuse.

4. What are the variants and commonalities that General Motors has been using in their vehicles? Give three examples for variants and three examples for commonalities from the text and explain why it is a variant or a commonality.

In terms of commonalities, all vehicles have doors, interior lighting and exterior lighting (12). These are commonalities because GM is not producing a car without doors, interior lighting or exterior lighting.

Possible engine options are variants. All cars have engine as a commonality but there are hybrid engines, internal-combustion engines (11).

There are different specs options for customers to choose. For example an expensive vehicle would have park assist and lane keep assist, however base option of a vehicle would not carry these hardwares (12). So there is a variation in terms of specs packages.

Presence of exterior lighting has variety. There are several exterior headlight types like low beam headlights, high beam headlights, tail lamps, brake lights, parking lights, daytime running lights, front fog lamps, rear fog lamps, cornering lamps, reversing lamps, and hazard flashes (12). A vehicle has to carry an exterior lighting but does not have to carry all of these. So some variance occurs according to legislations of a particular country or specs package of a vehicle. For example, probably a low-price vehicle would not have fog lamps and daytime running lights. So differences in exterior lightings cause variety.

5. a) What is the strategy for architectural decomposition? In which steps do engineers use SPLE? Explain briefly.

In terms of architectural decomposition, there are four types of architecture: functional architecture, implementation architecture, deployment architecture and vehicle application architecture (14, 15).

Functional architecture is the division of the domains. Each domain consists of functionality packages. A functionality can be in touch with more than one domain (14).

Implementation architecture covers the management of domains through the subsystems. Subsystems decomposed into functions and functions into functional elements. Requirements written for each function and functional elements and components decided according to requirements (14).

Deployment architecture simply manages the deployment issues. Each component has to be assigned to proper topology (15).

Vehicle application architecture is the phase which all planning starts to create something concrete. It deals with positions, types and qualities of components which be placed in a vehicle (15).

b) How does SPLE affect the roles and responsibilities of the workers? Explain briefly.

SPLE provides unique roles for the production and certain job definitions for these roles. There are four different roles in GM: functional architects, product line integration engineer, feature owner and asset owner (17). In brief, feature owners are the deciders of features and they state the requirements for these features. Functional architects maintain the functional architecture taxonomy (16). These are the engineers who build the SPLE models. Other teams don't have to have detailed information about the features which they will include to their car, so for the integration for different subsystems and features, product line integration engineers come up (16). Lastly, asset owners are sort of requirements engineers and who decide the variation points from the existing features (17).

All in all SPLE provides smooth and collaborative work experience by putting clear borders between job definitions. By the existing SPLE, an engineer does not have to know everything about the product line and production lifecycle. SPLE give chance to focus on a specific area to the engineers.