

Topic 27

Overview of Domain Engineering

- The **prerequisite** for following this (part of the) lecture is that you are ready now to embark on the long journey of getting to understand the first of the three core phases of software development.
- The **aims** are
 - ★ to present a capsule view of stages and steps of domain engineering, and
 - ★ to present a capsule view of the documents that result from domain engineering.

- The **objective** is
 - ★ to make you feel at ease with the very many stages and steps of domain development, and the very many parts of resulting documents.
- The **treatment** is informal and systematic.

Introduction

- As has been argued before:
 - ★ Before we can design the software, we must understand its requirements.
 - ★ And before we can develop requirements, we must understand the application domain.
- In earlier lectures we reviewed domain engineering.
- Now we give a more systematic and comprehensive treatment.
- We shall emphasize principles, techniques and tools of domain engineering.

A Review of Why Domain Engineering?

- **Characterisation 8.139** By a *domain model* we understand the meaning of a domain description. ■
- **Characterisation 8.140** By a *domain description* we mean a document (or a set of documents) which describes what the domain is, its entities, functions, events and behaviours. ■
- **Characterisation 8.141** By a *domain theory* we mean a set of theorems that are claimed to hold of the domain model. ■
- **Characterisation 8.142** By *domain engineering* we mean the processes overviewed in this chapter and otherwise detailed in this part. ■

- An Analogy:
 - ★ Just as physicists have researched and developed models of Mother Nature for at least 500 years,
 - ★ and just as classical engineers have designed artifacts based on the theories of the natural sciences,
 - ★ so we shall advocate research into and the development of theories of the man-made domains in which human activities, rather than nature, play the major role.
 - ★ Then we can develop software more believably.

- To research and develop domain theories is a new activity.
- But many present software engineering processes already touch upon domain engineering.
- In these lectures we bring domain engineering *more out into the open*, thus simplifying many past concerns of software engineering, especially those of requirements engineering.
- That is, we strongly think that many previously — by other authors — advocated issues of requirements engineering become far easier to handle (or they outright “disappear”) once we have done our domain engineering job!
- So we claim, at least!

Overview of Lecture

- Proper domain engineering, i.e., the proper development of a domain model, proceeds in stages:
 - ★ identification of domain stakeholders
 - ★ domain acquisition
 - ★ domain analysis and concept formation
 - ★ domain modelling
 - ★ domain validation and verification
 - ★ domain theory formation

Domain Stakeholders and Their Perspectives

- **Characterisation 8.143** By a *domain stakeholder* we shall understand
 - a person, or a group of persons, united somehow in their common interest in, or dependency on the domain; or
 - an institution, an enterprise or a group of such, (again) characterised (and, again, loosely) by their common interest in or dependency on the domain

Characterisation 8.144 By a *domain stakeholder perspective* we understand

- the, or an, understanding of the domain shared by
- the specifically identified stakeholder group —
- a view that may differ from one stakeholder group to another stakeholder group of the same domain

Domain Stakeholders Without clearly identifying and liaising with all relevant domain stakeholders one cannot hope to construct a believable domain model.

Domain Acquisition and Validation

Characterisation 8.145 By *domain acquisition* we understand

- the gathering, from domain stakeholders, from literature and from our observations, of
- knowledge about the domain.
- This knowledge includes
- phenomenological *entities, functions, events and behaviours*,
- with this “gathering” being manifested in terms of rough statements (i.e., fragments of sketches)

Characterisation 8.146 By *domain validation* we understand

- the assurance, with stakeholders, notably clients, that
- the domain descriptions produced as a result of
- domain acquisition, domain analysis, concept formation and domain modelling (the latter including the description)
- is commensurate with how the stakeholders view the domain

Domain Analysis and Concept Formation

Characterisation 8.147 By *domain analysis* we understand

- a study of domain acquisition (rough) statements,
- with the aim of discovering inconsistencies, conflicts and incompletenesses within,
- as well as with the aim of forming concepts from,
- these domain acquisition statements

Characterisation 8.148 By *domain concept formation* we understand

- the abstraction of domain phenomena, as hinted at by domain acquisition (rough) statements,
- into concepts

Domain Facets

Characterisation 8.149 By a *domain facet* we understand

- one amongst a finite set of generic ways
- of analysing a domain, that is,
- a view of the domain
- such that the different facets cover conceptually different views,
- and such that these views together cover the domain

We list the main categories of domain facets:

- *business procedure* facets
- *intrinsic* facets
- *support technology* facets
- *management and organisation* facets
- *rules and regulations* facets
- *script* facets
- *human behaviour*

Domain Model \equiv **Model of Domain Facets** So by a domain model we mean a set of one or more commensurate models of domain facets — these may possibly be rewritten (and reformalised) into one consolidated model.

Auxiliary Stages of Domain Development

- The *auxiliary stages of development* include the following:
 - * domain (knowledge) acquisition
 - * domain (knowledge) analysis and concept formation
 - * domain (knowledge) verification
 - * domain (knowledge) validation
 - * domain theory formation.

- Suffice it for now to say that they “adorn” the major stages of domain facet modelling:
 - * to model a domain facet we must first acquire it;
 - * then we must analyse what has been acquired, and form concepts from what has been analysed;
 - * then we can describe it: (a) roughly, (b) terminologise it, (c) narrate and (d) possibly formalise the facet. Stages (a–d) form the major stages.
- In between these latter descriptive activities, we
 - * verify properties of the domain model,
 - * validate the domain facet description (i.e., the model), and
 - * possibly we build up elements of a theory of the domain.

The Domain Model Document A Preview of Things to Come

- The aim of domain engineering is to create informative, descriptive and analytic documents about and constituting the domain model.
- Therefore it is important to always keep in mind what a possible contents listing could be of such a complete set of documents.
- We shall therefore outline, in “capsule” form, what a possible, and, to us, desirable *table of contents* structure could be of such a set of domain documents.
- The aim of these next lectures is, therefore, to present the principles, techniques and tools for creating, i.e., developing, such sets of domain documents.

Contents of a Domain Model Document

A Generic Domain Documentation Contents Listing

- | | |
|----------------------------------|-------------------------------|
| 1. Information | (h) Implicit/Derivative Goals |
| (a) Name, Place and Date | (i) Synopsis |
| (b) Partners | (j) Standards Compliance |
| (c) Current Situation | (k) Contracts |
| (d) Needs and Ideas | (l) The Teams |
| (e) Concepts and Facilities | i. Management |
| (f) Scope and Span | ii. Developers |
| (g) Assumptions and Dependencies | iii. Client Staff |
| | iv. Consultants |

2. Descriptions

- (a) Stakeholders
- (b) The Acquisition Process
 - i. Studies
 - ii. Interviews
 - iii. Questionnaires
 - iv. Indexed Description Units
- (c) Terminology
- (d) Business Processes

(e) Facets:

- i. Intrinsic
- ii. Support Technologies
- iii. Management and Organisation
- iv. Rules and Regulations
- v. Scripts
- vi. Human Behaviour
- (f) Consolidated Description

3. Analyses

- (a) Domain Analysis and Concept Formation
 - i. Inconsistencies
 - ii. Conflicts
 - iii. Incompleteness
 - iv. Resolutions
- (b) Domain Validation
 - i. Stakeholder Walk-Throughs
 - ii. Resolutions
 - (c) Domain Verification
 - i. Model Checkings
 - ii. Theorems and Proofs
 - iii. Test Cases and Tests
 - (d) (Towards a) Domain Theory

Further Structure of Next Lectures

- We start with a brief analysis of the stakeholder concept.
- To know how to properly acquire domain knowledge we believe that it is important to know what the end result of domain engineering should be.
 - * We therefore detail two core aspects of a domain model:
 - ◊ the attributes of the phenomena and concepts modelled,
 - ◊ and the facets of domain phenomena and concepts.
- Thus we present principles and techniques for those aspects of domain models.
- And we do so before we treat principles and techniques for domain acquisition.
- Then we cover domain analysis and concept formation — on which the domain models build.
- Once domain models are believed ready, they can be validated, and stages and steps of domain modelling work can be verified — often during domain modelling.