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The Mechanics of Domain-Driven Design (30 Pages)

> When eating an elephant, take one bite at a time.
>
> — Creighton Abrams

As mentioned in the previous chapter, many things can render a project to veer off-course. The intent of DDD is to decompose complex problems on the basis of clear domain boundaries and the communication between them. In this chapter, we look at a set of tenets and techniques to arrive at

a collective understanding of the problem at hand in the face of ambiguity, break it down into manageable chunks and translate it into reliably working software.

Understanding the problem

Every decision we take regarding the organization, be it requirements, architecture, code has business and user consequences. In order to conceive, architect, design, build and evolve software effectively, our decisions need to aid in creating the optimal business impact. This can only be achieved if we have a clear understanding of the problem we intend to solve. This leads us to the realization that there exist two distinct domains when arriving at the solution for a problem:

Problem domain

A term that is used to capture information that simply defines the problem while consciously avoiding any details of the solution. It includes details like **why** we are trying to solve the problem, **what** we are trying to achieve and **how** it needs to be solved. It is important to note that the *why*, *what* and *how* are from the perspective of the customers/stakeholders, not from the perspective of the engineers providing software solutions to the problem.

Consider the example of a retail bank which already provides a checking account capability for their customers. They want access to more liquid funds. To achieve that, they need to encourage customers to maintain higher account balances. To do that, they are looking to introduce a new product called the *premium checking account* with additional features like higher interest rates, overdraft protection, no-charge ATM access, etc. The problem domain expressed in the form of why, what and how is shown here:

Table 1. Problem domain: why, what and how

Question	Answer
Why	Bank needs access to more liquid funds
What	Have customers maintain higher account balances
How	By introducing a new product — the premium checking account with enhanced features

Solution domain

A term used to describe the environment in which the solution is developed. In other words, the process of translating requirements into working software (this includes design, development, testing, deployment, etc). Here the emphasis is on the *how* of the problem being solved. However, it is very difficult to arrive at a solution without having an appreciation of the why and the what.

Building on the previous premium checking account example, the code-level solution for this problem may look something like this:

```
class PremiumCheckingAccountFactory {

    Account openPremiumCheckingAccount(Applicant applicant,
                                       MonetaryAmount initialAmount) {

        Salary salary = checkEmployed(applicant);

        if (salary.isBelowThreshold()) {
            throw new InsufficientIncomeException(applicant);
        }

        Account account = Account.createFor(applicant);
        account.deposit(initialAmount);
        account.activate();
        return account;
    }
}
```

This likely appears like a significant leap from a problem domain description, and indeed it is. Before a solution like this can be arrived at, there may need to exist multiple levels of refinement of the problem. As mentioned in the previous chapter, this may lead to inaccuracies in the understanding of the problem, resulting in a solution that may be good, but not one that solves the problem at hand. Let's look at how we can continuously refine our understanding by closing the gap between the problem and the solution domain.

What is a *domain*?

The foundational concept when working with domain-driven design is the notion of a domain. But what exactly is a domain? The word *domain*, which has its origins in the 1600s to the Old French word *domaine* (power), Latin word *dominium* (property, right of ownership) is a rather confusing word. Depending on who, when, where and how it is used, it can mean different things:

Noun [edit]

domain (*plural* **domains**)

1. A geographic area owned or controlled by a single person or organization. [quotations ▼]
   *The king ruled his **domain** harshly.*
2. A field or sphere of activity, influence or expertise.
   *Dealing with complaints isn't really my **domain**: get in touch with customer services.*
   *His **domain** is English history.*
3. A group of related items, topics, or subjects. [quotations ▼]
4. (*mathematics*) The set of all possible mathematical entities (points) where a given function is defined.
5. (*mathematics*, *set theory*) The set of input (argument) values for which a function is defined.
6. (*mathematics*) A ring with no zero divisors; that is, in which no product of nonzero elements is zero.
   Hyponym: integral domain
7. (*mathematics*, *topology*, *mathematical analysis*) An open and connected set in some topology. For example, the interval (0,1) as a subset of the real numbers.
8. (*computing*, *Internet*) Any DNS domain name, particularly one which has been delegated and has become representative of the delegated domain name and its subdomains. [quotations ▼]
9. (*computing*, *Internet*) A collection of DNS or DNS-like domain names consisting of a delegated domain name and all its subdomains.
10. (*computing*) A collection of information having to do with a domain, the computers named in the domain, and the network on which the computers named in the domain reside.
11. (*computing*) The collection of computers identified by a domain's domain names.
12. (*physics*) A small region of a magnetic material with a consistent magnetization direction.
13. (*computing*) Such a region used as a data storage element in a bubble memory.
14. (*data processing*) A form of technical metadata that represent the type of a data item, its characteristics, name, and usage. [quotations ▼]
15. (*taxonomy*) The highest rank in the classification of organisms, above kingdom; in the three-domain system, one of the taxa *Bacteria*, *Archaea*, or *Eukaryota*.
16. (*biochemistry*) A folded section of a protein molecule that has a discrete function; the equivalent section of a chromosome

Figure 1. **Domain***: Means many things depending on context*

In the context of a business however, the word domain covers the overall scope of its primary activity — the service it provides to its customers. This is also referred as the ***problem domain***. For example, Tesla operates in the domain of electric vehicles, Netflix provides online movies and

shows, while McDonald's provides fast food. Some companies like Amazon, provide services in more than one domain — online retail, cloud computing, among others. These domains tend to be fairly complex. To cope with this complexity, it is usual to decompose these domains into more manageable pieces called subdomains. We will examine subdomains in more detail in the next chapter.

Domain Experts

To run a successful digital business, you need specialists — those who have a deep and intimate understanding of the domain. Domain experts are subject-matter experts (SMEs) who have a very strong grasp of the business. Domain experts may have varying degrees of expertise. Some SMEs may choose to specialize in specific subdomains, while others may have a broader understanding of how the overall business works.

Any modern software team requires expertise in at least two areas — the functionality of the domain and the art of translating it into high quality software. While the domain experts specify the **why** and the ***what***, technical experts (software developers) specify the ***how***. Strong contributions and synergy between both groups is absolutely essential to ensure sustained high performance and success.

Promoting a Shared Understanding

Previously, we saw how organizational silos can result in valuable information getting diluted. At a credit card company I used to work with, the words plastic, payment instrument, account, PAN (Primary Account Number), BIN (Bank Identification Number), card were all used by different team members to mean the exact same thing - the ***credit card*** when working in the same area of the application. On the other hand, a term like ***user*** would be used to sometimes mean a customer, a relationship manager, a technical customer support employee. To make matters worse, a lot of these muddled use of terms got implemented in code as well. While this might feel like a trivial thing, it had far-reaching consequences. Product experts, architects, developers, all came and went, each regressively contributing to more confusion, muddled designs, implementation and technical debt with every new enhancement — accelerating the journey towards the dreaded, unmaintainable, big ball of mud.

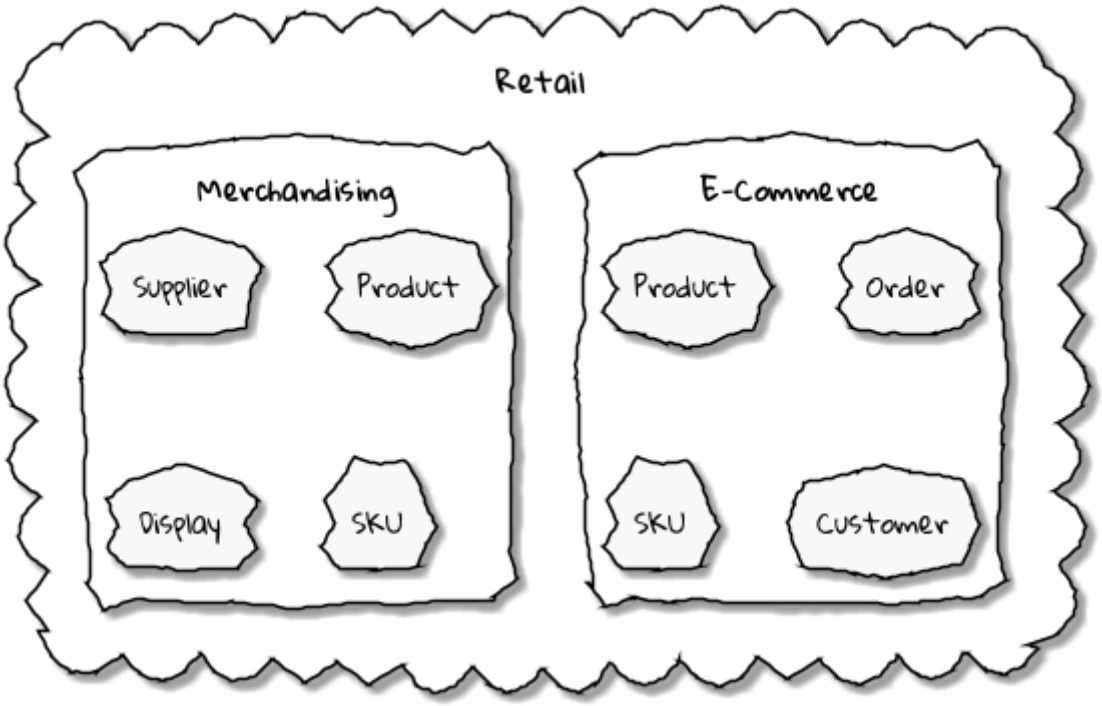
DDD advocates breaking down these artificial barriers, and putting the domain experts and the developers on the same level footing by working collaboratively towards creating what DDD calls a ***ubiquitous language*** — a shared vocabulary of terms, words, phrases to continuously enhance the collective understanding of the entire team. This phraseology is then used actively in every aspect of the solution: the everyday vocabulary, the designs, the code — in short by **everyone** and **everywhere**. Consistent use of the common ubiquitous language helps reinforce a shared understanding and produce solutions that better reflect the mental model of the domain experts.

Evolving a Domain Model and a Solution

The ubiquitous language helps establish a consistent albeit informal lingo among team members. To enhance understanding, this can be further refined into a formal set of abstractions — a ***domain model*** to represent the solution in software. It is very important to note that this domain model is modeled to fall within the context of a single subdomain for which a solution is being explored, not

the entire domain of the business. This boundary is termed as a ***bounded context*** i.e. the ubiquitous language and domain model are only valid within those bounds and context — not outside of it. This means that the system as a whole can be represented as a set of bounded contexts which have relationships with each other. These relationships define how these bounded contexts can integrate with each other and are called ***context maps***.

Care should be taken to retain focus on solving the business problem at hand at all times. Teams will be better served if they expend the same amount of effort modeling business logic as the technical aspects of the solution. To keep accidental complexity in check, it will be best to isolate the infrastructure aspects of the solution from this model. These models can take several forms, including conversations, whiteboard sessions, documentation, diagrams, tests and other forms of architecture fitness functions. It is also important to note that this is **not** a one-time activity. As the business evolves, the domain model and the solution will need to keep up. This can only be achieved through close collaboration between the domain experts and the developers at all times.



DDD has a catalog of strategic and tactical patterns which accelerate this process of continuous learning. In addition, modern techniques such as domain storytelling, event storming, and evolutionary architecture can greatly aid this process of evolving the ubiquitous language and domain model. We will examine all of these in much detail in upcoming chapters,

The thrust of DDD is that **one single model** form the bedrock of team communication, design, and implementation. While teams may and will indeed require a variety of means to express the model, it is very important to keep the executable code and the various representations up to date at all times.

What is a Subdomain?

The domain of a business (at least the successful ones) almost always encompasses fairly complex and abstract concepts. With a view to better deal with this complexity, domain-driven design advises decomposing the domain of a business into multiple manageable parts called **subdomains**.

This facilitates better understanding and makes it easier to arrive at a solution. For example, the online retail domain may be divided into subdomains such as product, inventory, rewards, shopping cart, order management, payments, shipping, etc. as shown below:

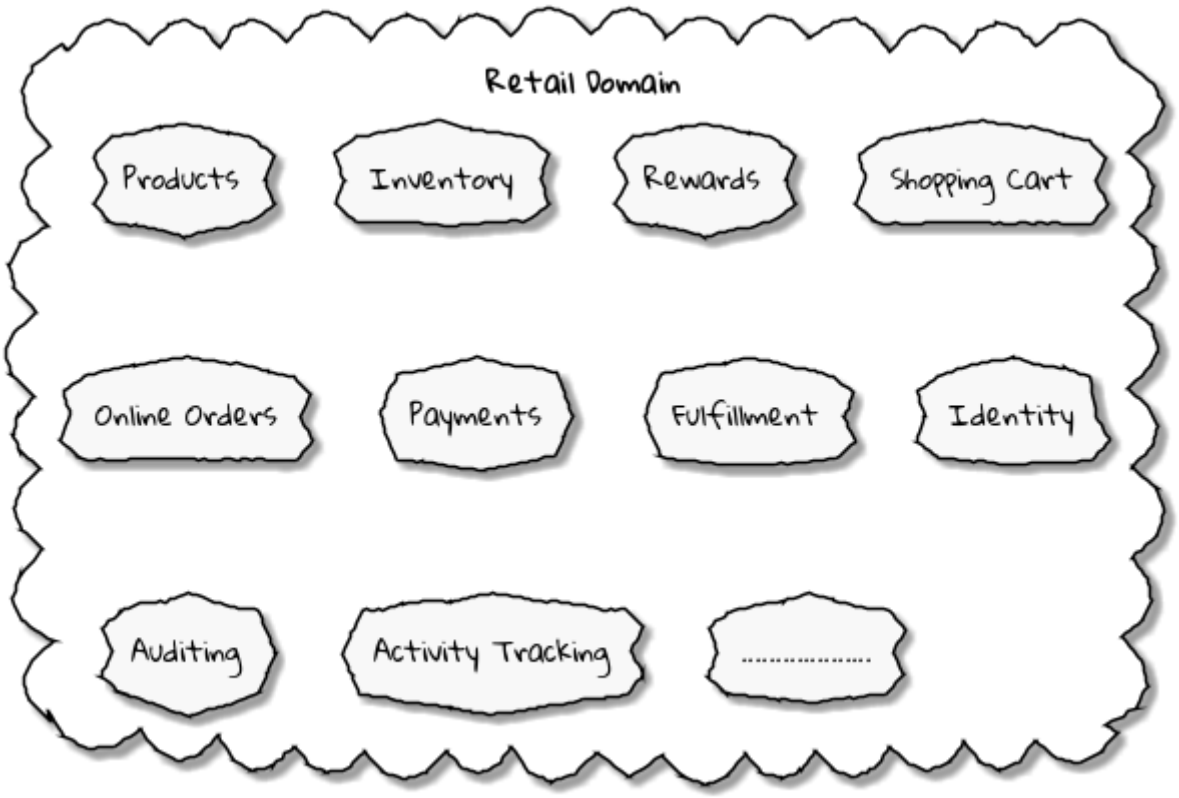


Figure 2. Subdomains in the Retail domain

In certain businesses, subdomains themselves may turn out to become very complex on their own and may require further decomposition. For instance, in the retail example above, it may be required to break the products subdomain into further constituent subdomains such as catalog, search, recommendations, reviews, etc. as shown below:

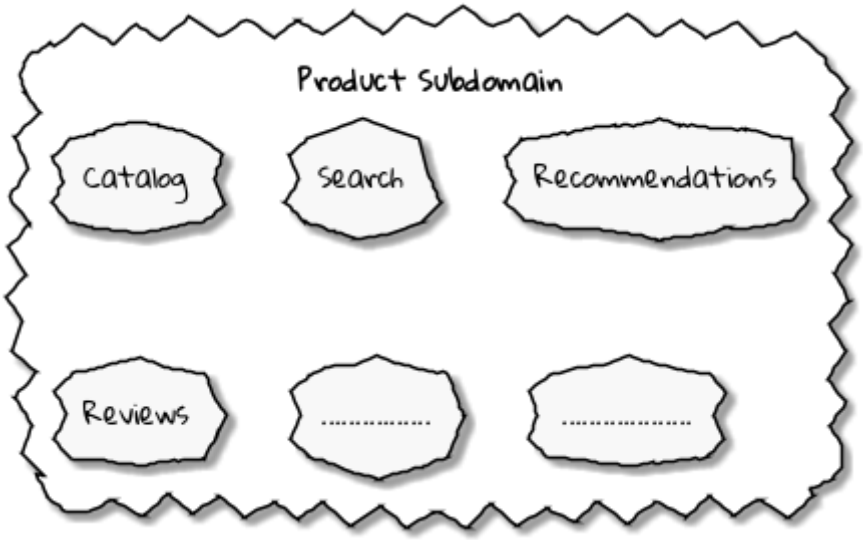


Figure 3. Subdomains in the Products subdomain

Further breakdown of subdomains may be needed until we reach a level of manageable complexity.

Types of Subdomains

Breaking down a complex domain into more manageable subdomains is a great thing to do. However, not all subdomains are created equal. With any business, the following three types of subdomains are going to be encountered:

- **Core**: The main focus area for the business. This is what provides the biggest differentiation and value. It is therefore natural to want to place the most focus on the core subdomain. In the retail example above, shopping cart and orders might be the biggest differentiation — and hence may form the core subdomains for that business venture. It is prudent to implement core subdomains in-house given that it is something that businesses will desire to have the most control over. In the online retail example above,
- **Supporting**: Like with every great movie, where it is not possible to create a masterpiece without a solid supporting cast, so it is with supporting or auxiliary subdomains. Supporting subdomains are usually very important and very much required, but may not be the primary focus to run the business. These supporting subdomains, while necessary to run the business, do not usually offer a significant competitive advantage. Hence it might be even fine to completely outsource this work or use an off-the-shelf solution as is or with minor tweaks. For the retail example above, assuming that online ordering is the primary focus of this business, catalog management may be a supporting subdomain.
- **Generic**: When working with business applications, one is required to provide a set of capabilities **not** directly related to the problem being solved. Consequently, it might suffice to just make use of an off-the-shelf solution For the retail example above, the identity, auditing and activity tracking subdomains might fall in that category.

It is important to note that the notion of core vs. supporting vs. generic subdomains is very context specific. What is core for one business may be supporting or generic for another. Identifying and distilling the core domain requires deep understanding and experience of what problem is being attempted to be solved.

The ubiquitous language and domain models

As we have discussed in the previous chapter, when a problem is presented to us, we subconsciously attempt to form mental representations of potential solutions. Further, the type and nature of these representations (models) may differ wildly based on factors like our understanding of the problem, our backgrounds and experiences, etc. This implies that it is natural for these models to be different. For example, the same problem can be thought of differently by various team members as shown here:

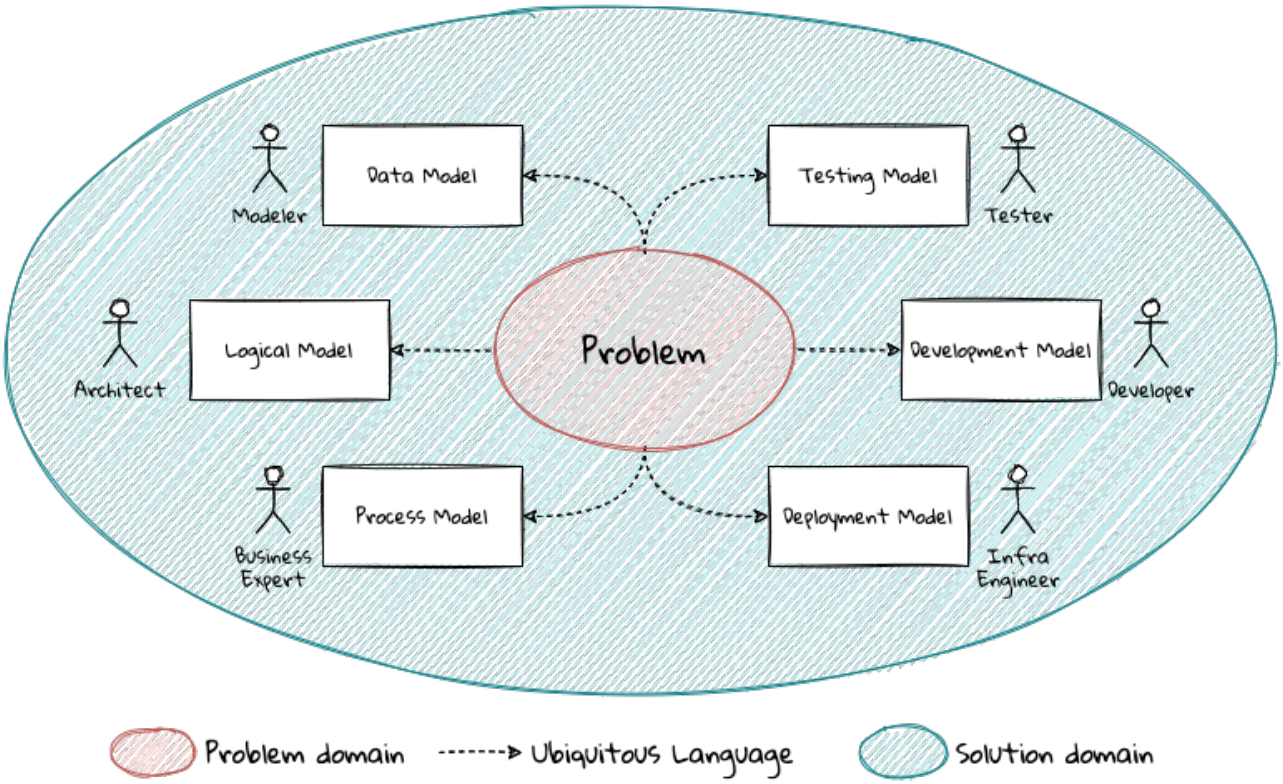


Figure 4. Multiple models to represent the solution to the problem using the ubiquitous language

As iillustrated here, the business expert may think of a process model, whereas the test engineer may think of exceptions and boundary conditions to arrive at a test strategy.

The illustration above is to depict the existence of multiple models. There may be several other perspectives, for example, a customer experience model, an information security model, etc. which are not depicted.

The idea of domain-driven design is for individuals in these varied roles to increase collaboration by promoting the use of the *ubiquitous language* at every step. This enhances the collective understanding, leading to a better quality of the models, and by extension, the quality of the solution. This approach mitigates the risk of the loss in fidelity of information as we transition organizational boundaries.

Modeling tools

Wardley maps

Impact maps

Business model canvas

Product strategy canvas

Domain model

Strategic design

Anemic domain models

Context maps

Bounded contexts

Implementing the solution

Tactical design

Entities

Value objects

Aggregates

Services

Repositories

Factories