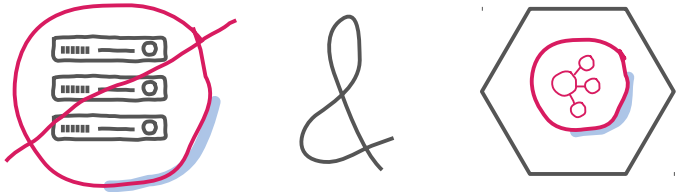


Designing a Serverless Application with Domain Driven Design

Susanne Kaiser
Independent Tech Consultant
@suksr

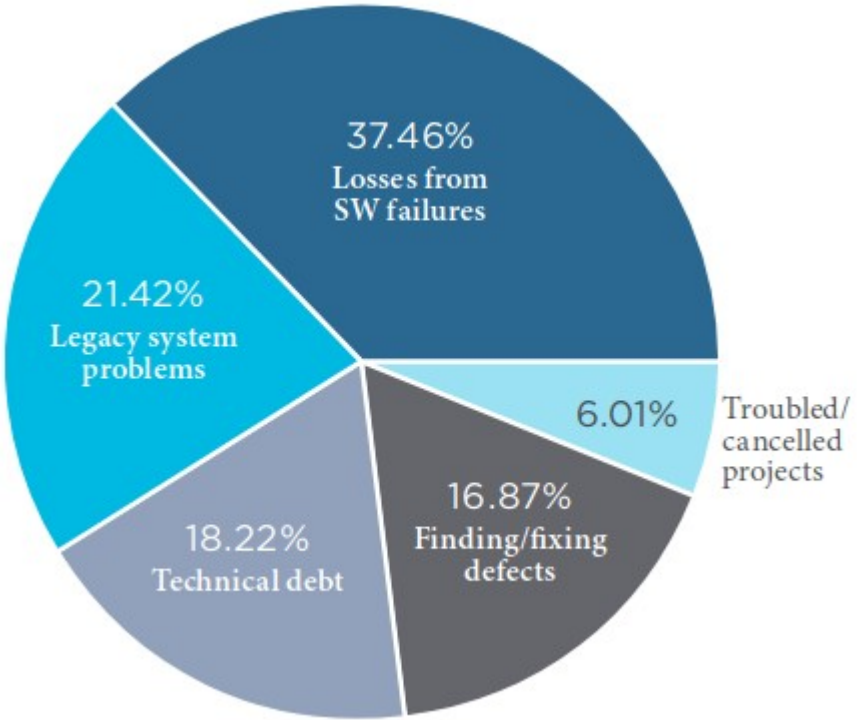
Costs of Poor Software Quality in the US in 2018 (by CISQ report)

$2,840,000,000,000

TWOTRILLIONEIGHTHUNDREDFOURTYBILLION USD

Source: https://www.it-cisq.org/the-cost-of-poor-quality-software-in-the-us-a-2018-report

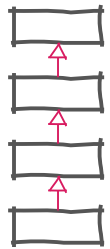
Areas of Cost Relating To Poor Software Quality



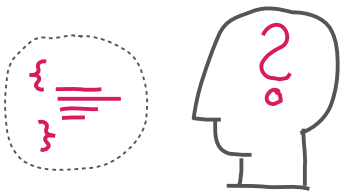
Source: https://www.it-cisq.org/the-cost-of-poor-quality-software-in-the-us-a-2018-report

Some Indicators for Poor Software Quality (extracted from CISQ report)

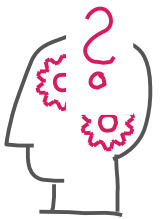
Increasing defect trend



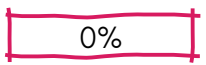
Large inheritance depth



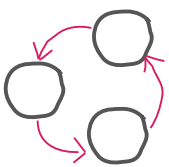
High amount of effort to understand piece of code



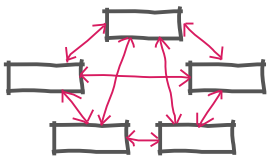
Lack of domain knowledge



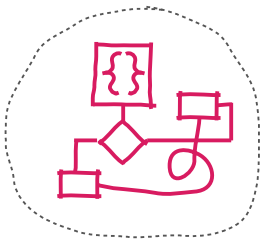
Low test coverage



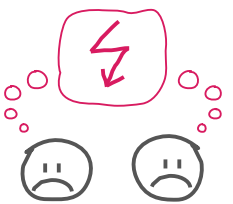
Cyclomatic complexity



High degree of class coupling



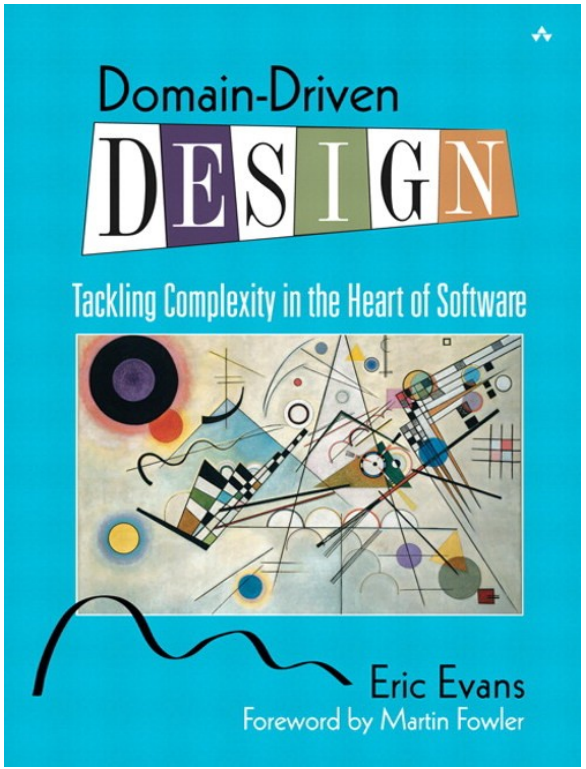
Badly engineered software

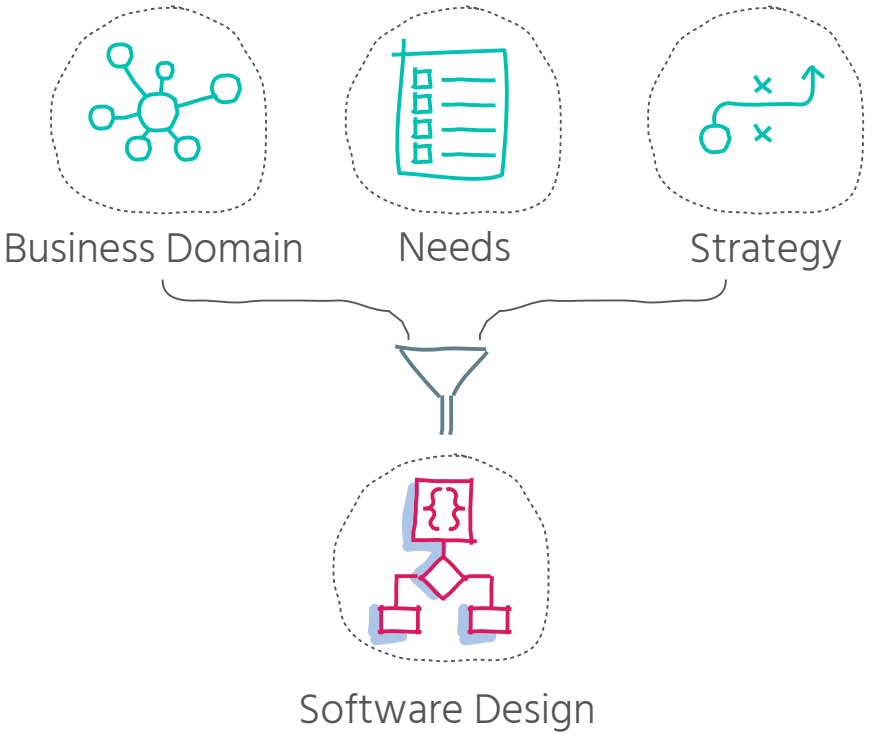


Communication and coordination breakdowns in (large) teams

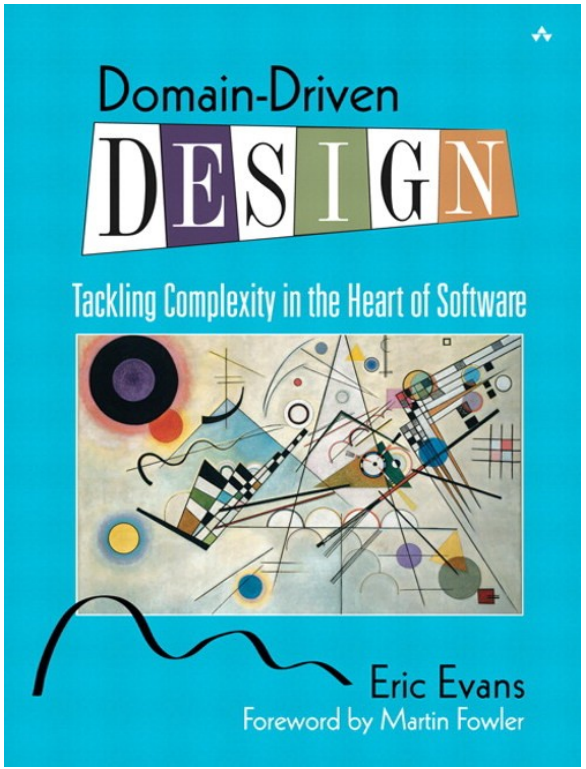
Based on: https://www.it-cisq.org/the-cost-of-poor-quality-software-in-the-us-a-2018-report

Domain Driven Design (DDD)





Domain Driven Design (DDD) – Terminology



Strategic Design
Tactical Design

Problem Space
Solution Space

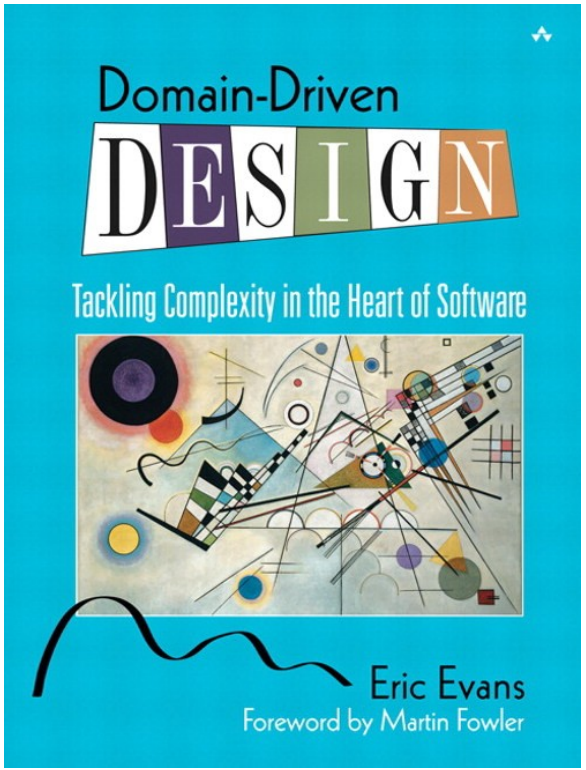
Core Subdomain
Supporting Subdomain
Generic Subdomain

Bounded Context
Ubiquitous Language

Context Maps
Anti-Corruption Layer
Shared Kernel
Open Host Service
Separate Ways
Partnership
Customer-Supplier
Conformist

Domain Model
Entity
Value Object
Aggregate
Repository
Factory
Application Service
Domain Service
Domain Event

DDD & Wardley Maps



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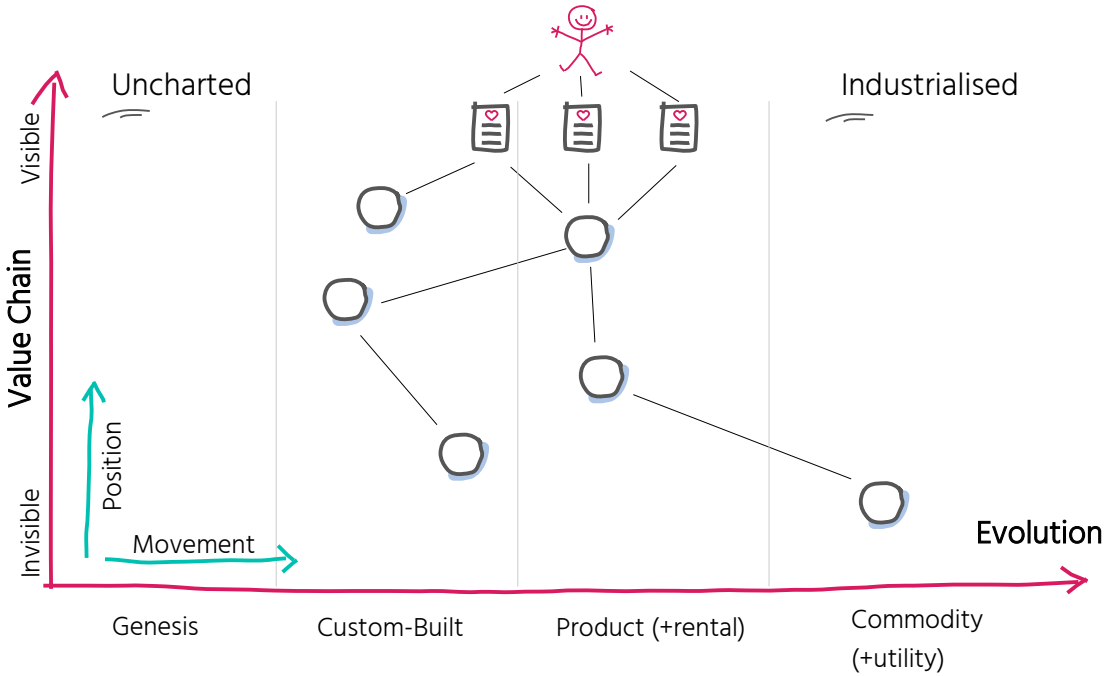
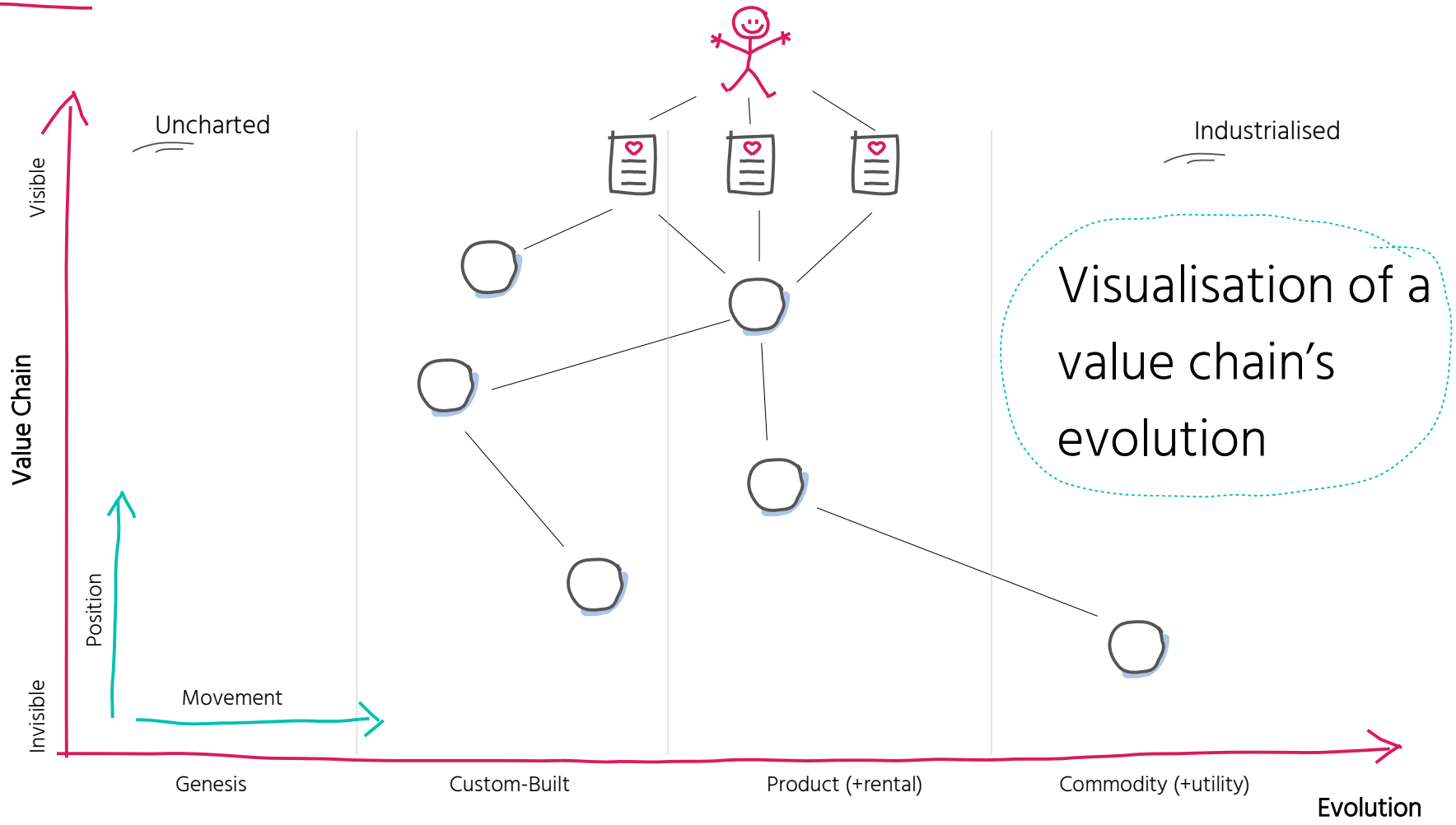


Wardley Maps BY SIMON WARDLEY



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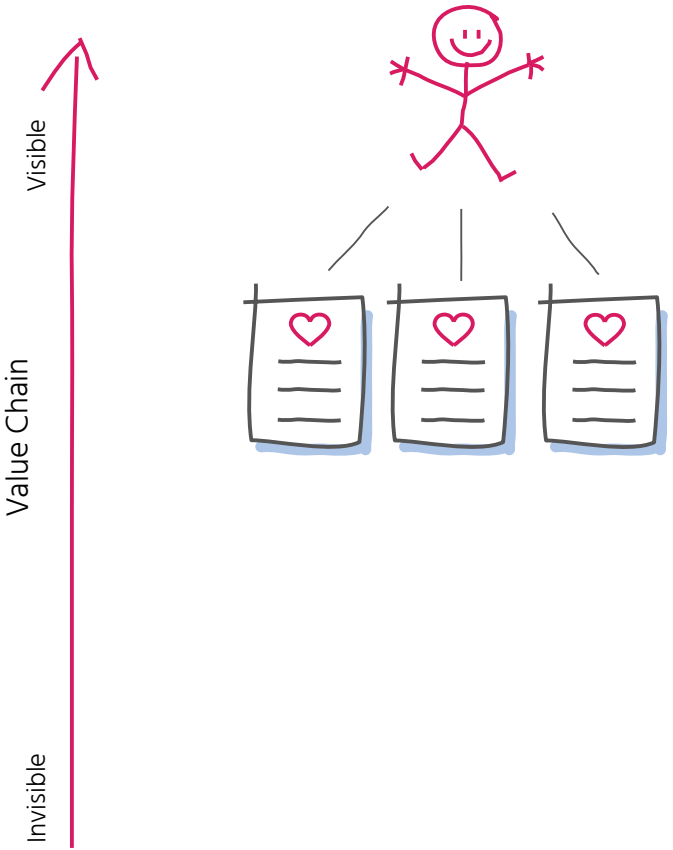
Wardley Maps – VALUE CHAIN

Who are your users?

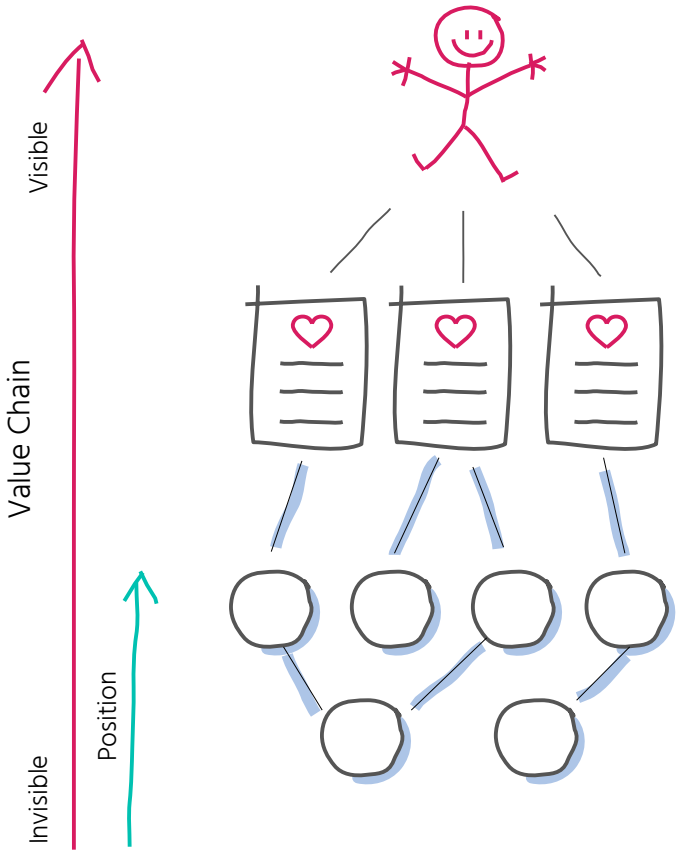
Wardley Maps – VALUE CHAIN



Who are your users?

What are your users' needs?

Wardley Maps – VALUE CHAIN

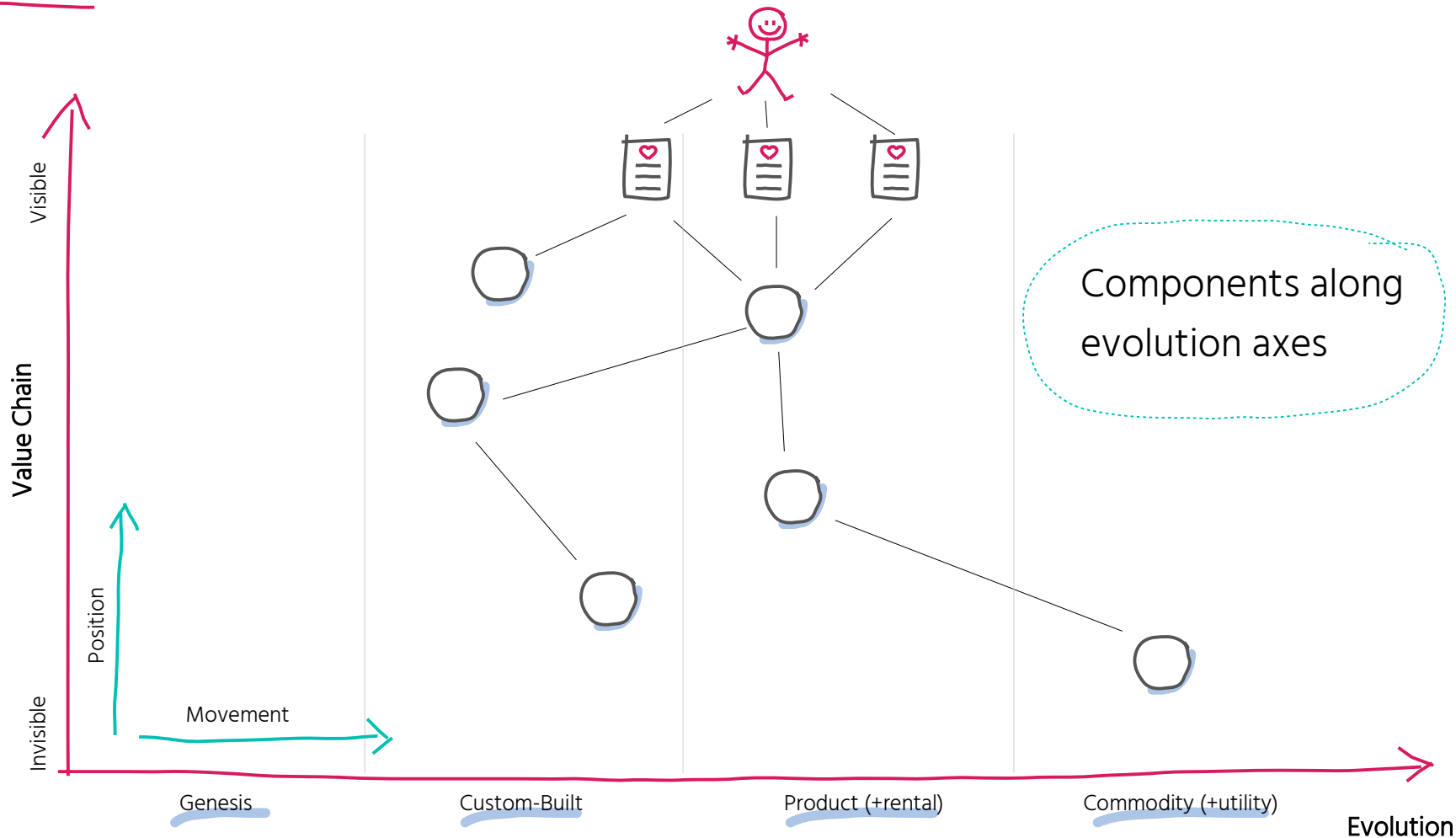


Who are your users?

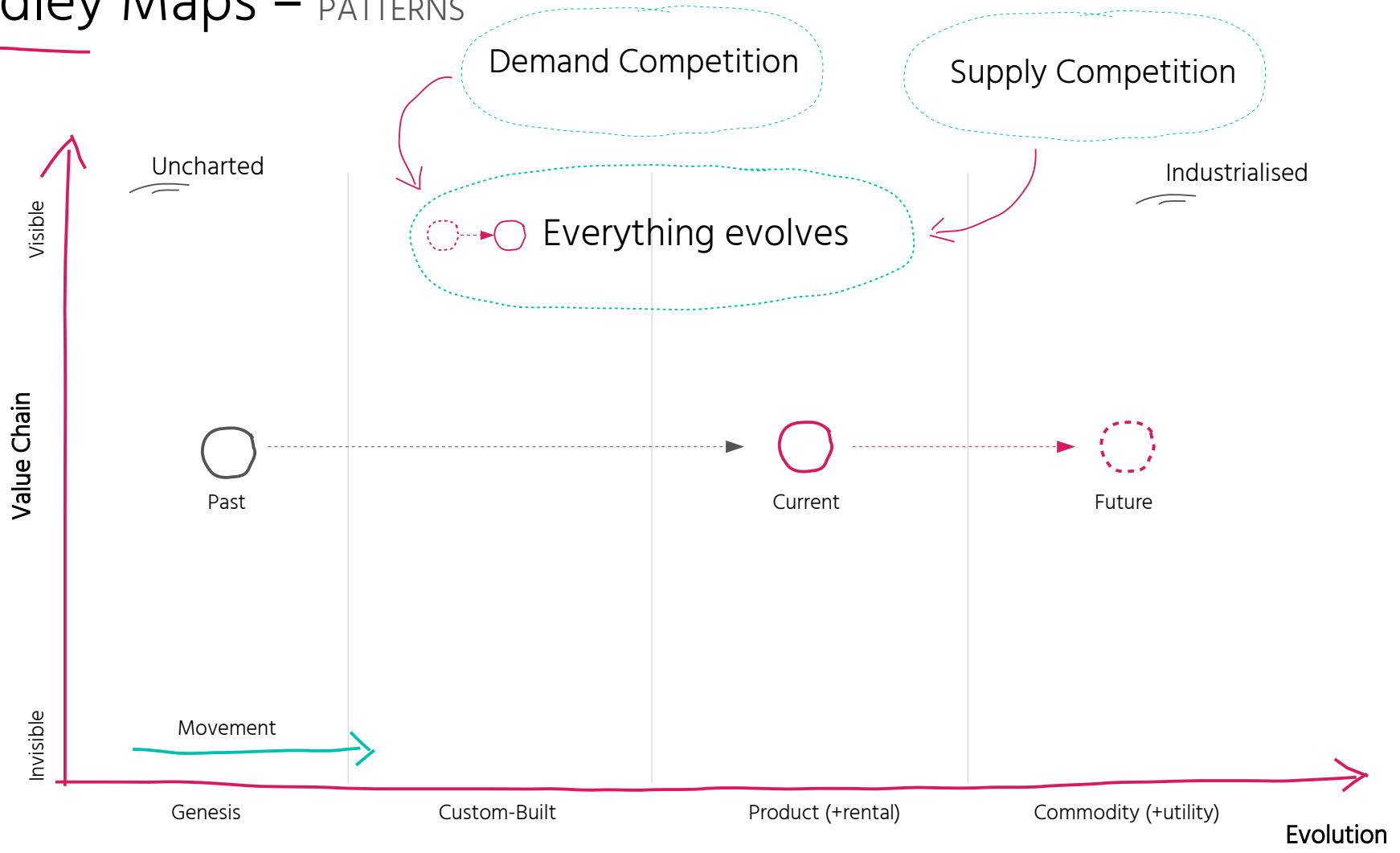
What are your users' needs?

What are the components/activities to fulfill your users' needs incl. dependencies?

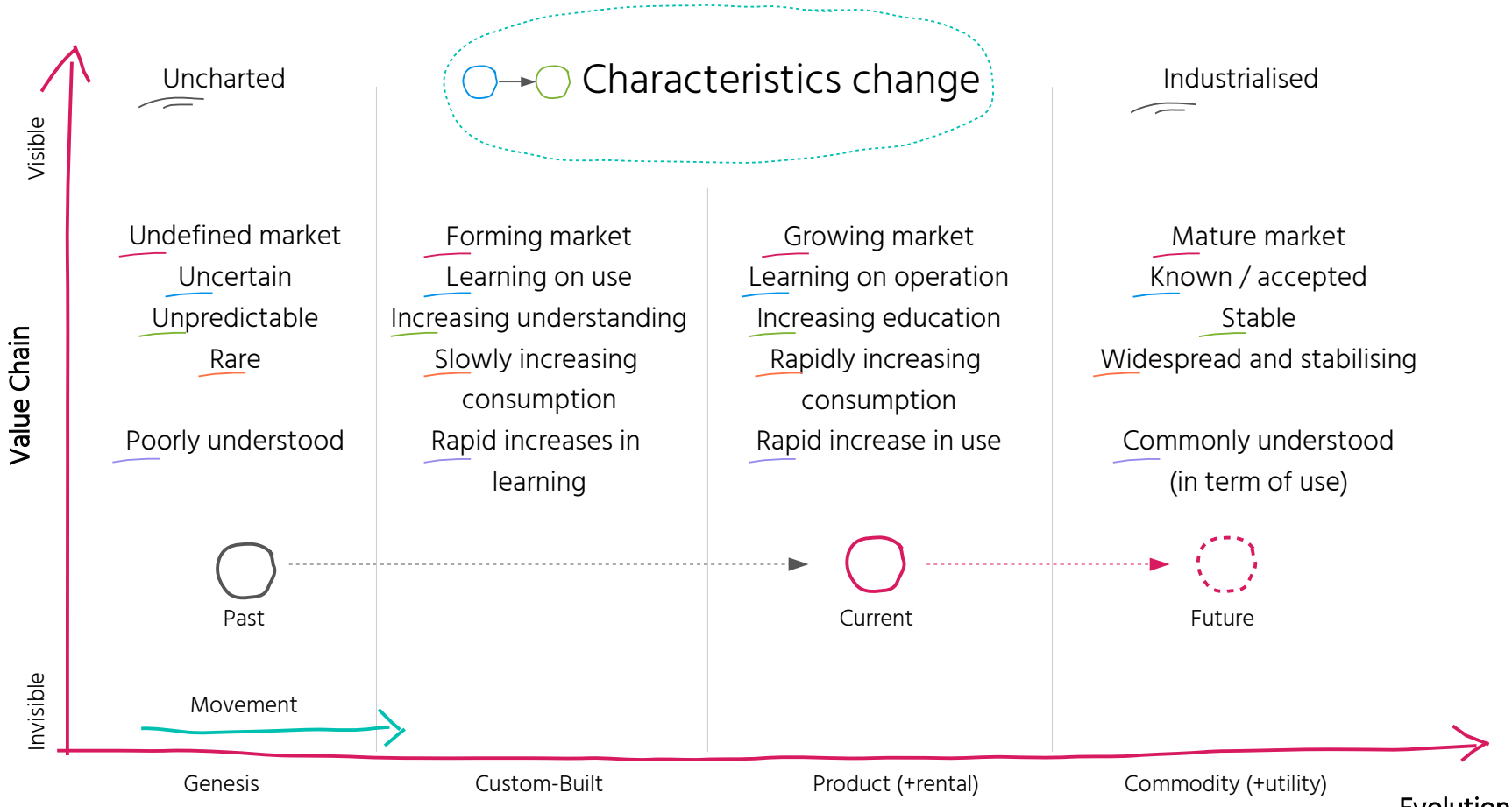
Wardley Maps – LANDSCAPE



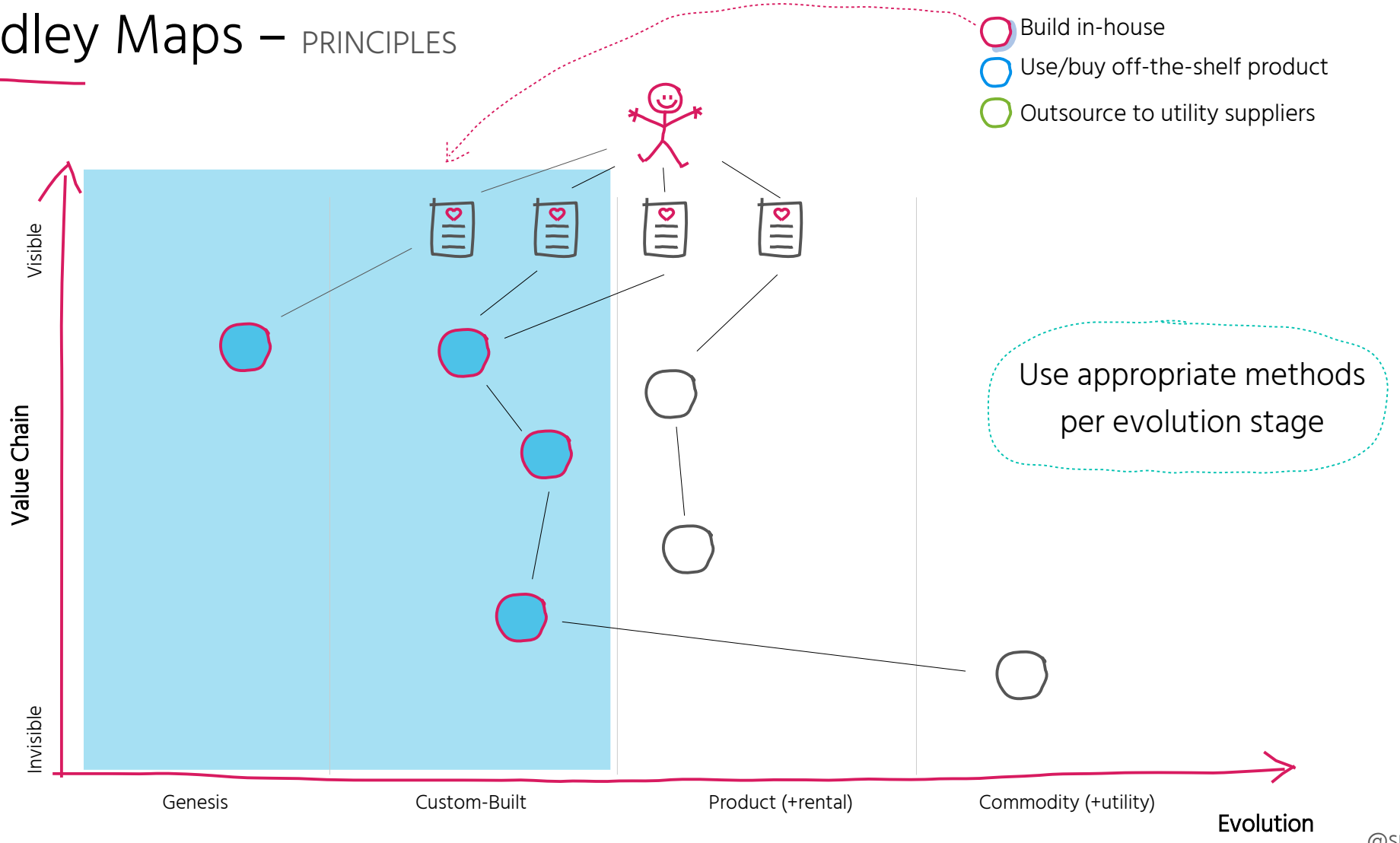
Wardley Maps – PATTERNS



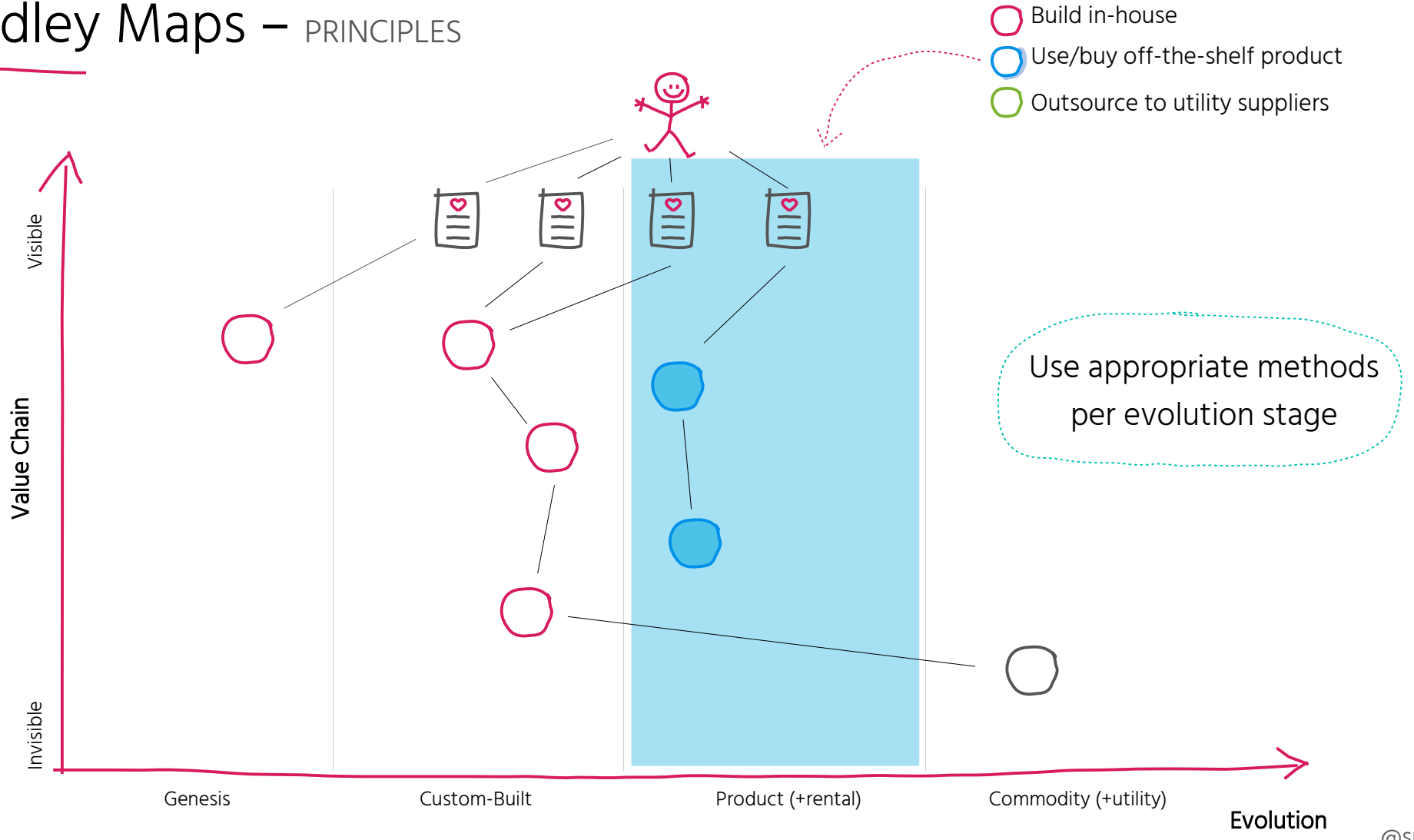
Wardley Maps – PATTERNS



Wardley Maps – PRINCIPLES



Wardley Maps – PRINCIPLES



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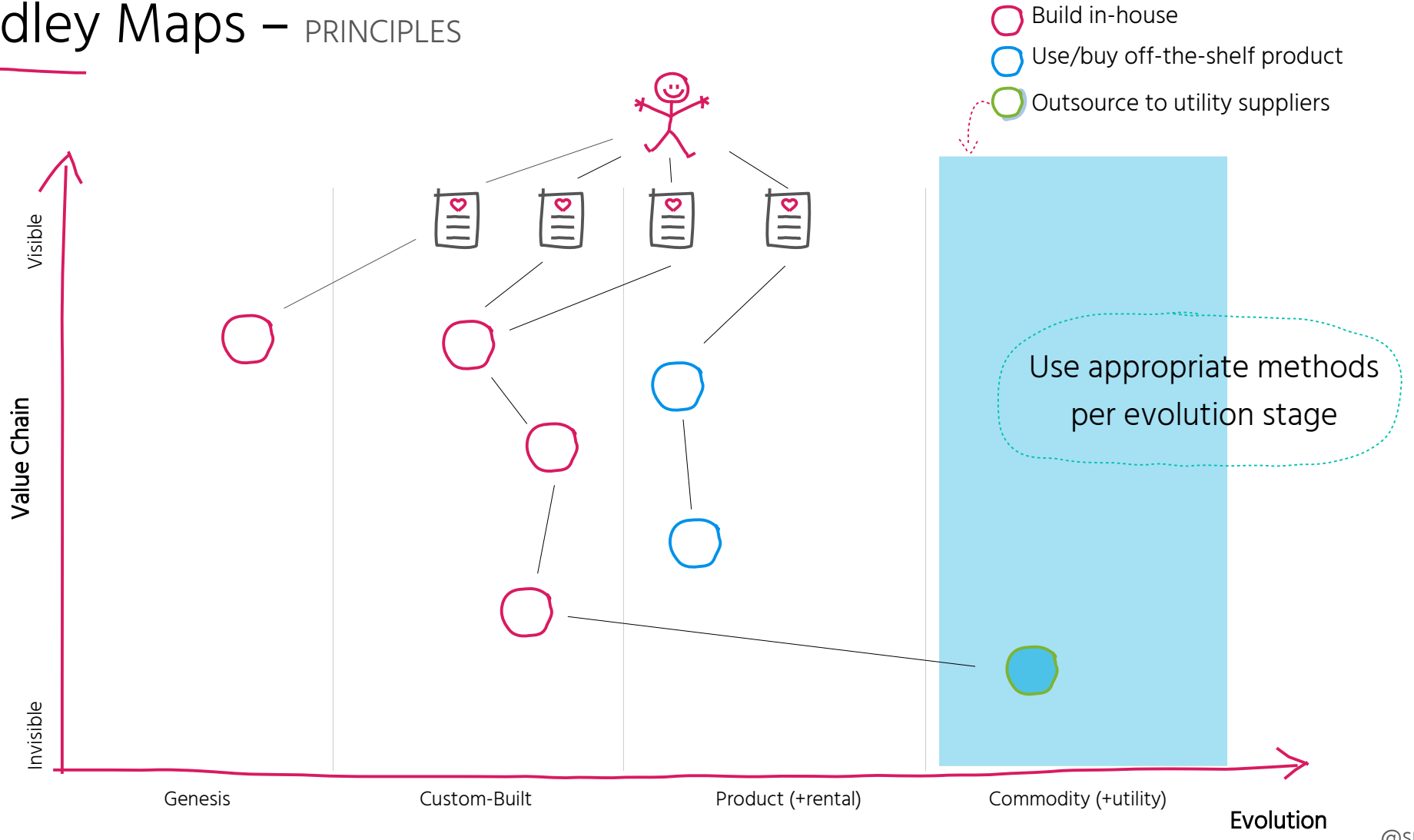
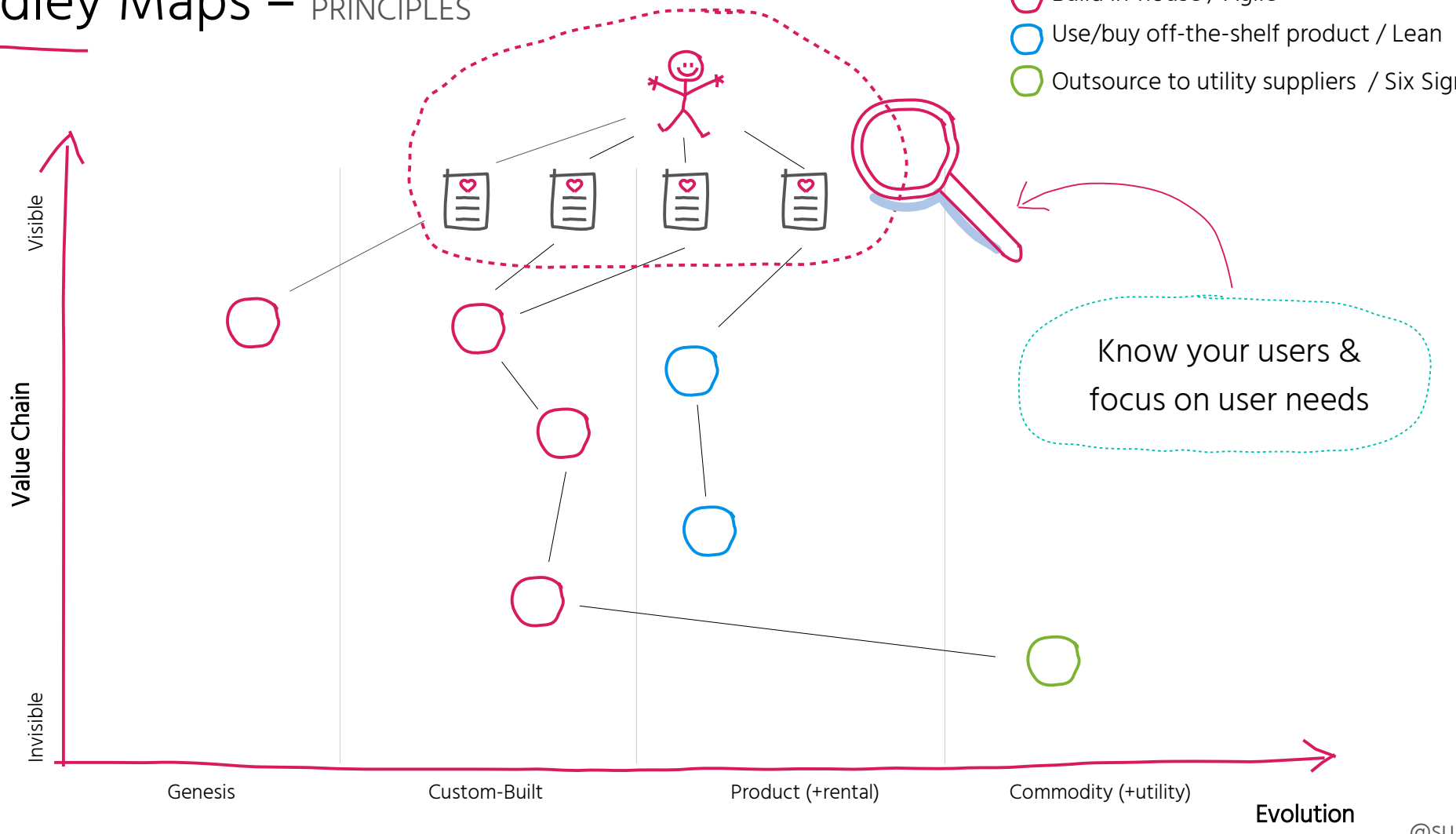
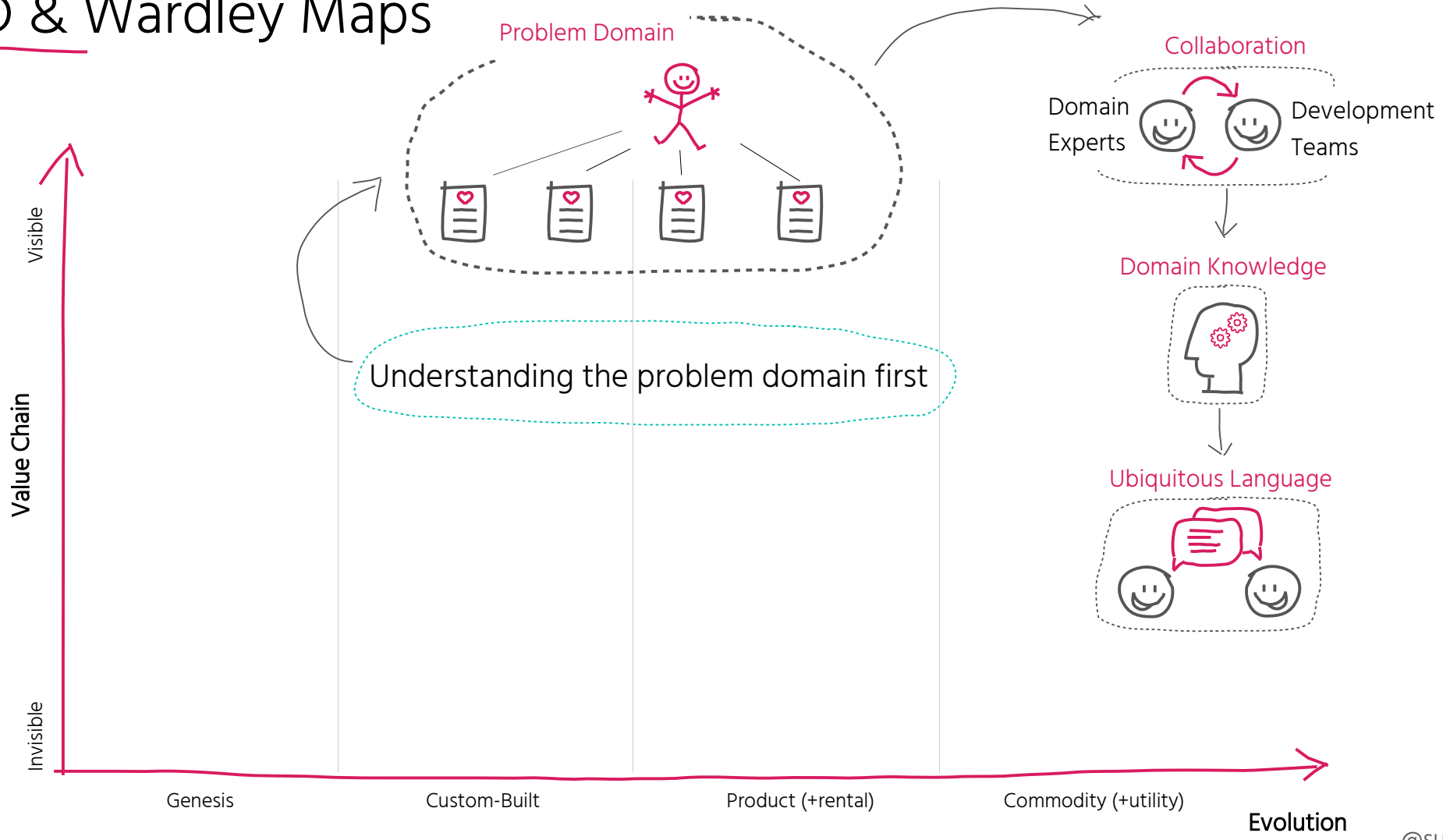


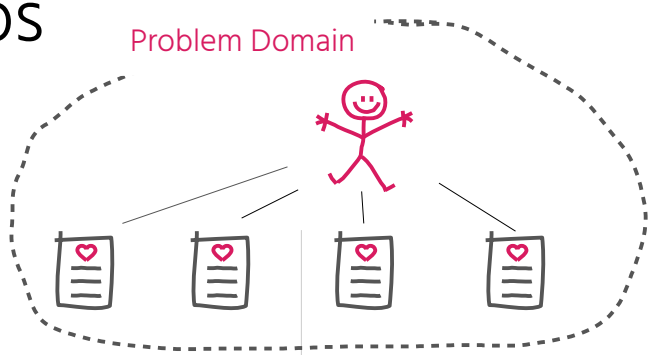
Wardley Maps – PRINCIPLES



DDD & Wardley Maps



DDD & Wardley Maps



DDD Patterns & Practices

Strategic Design

Tactical Design

Visible

Value Chain

Invisible

Genesis

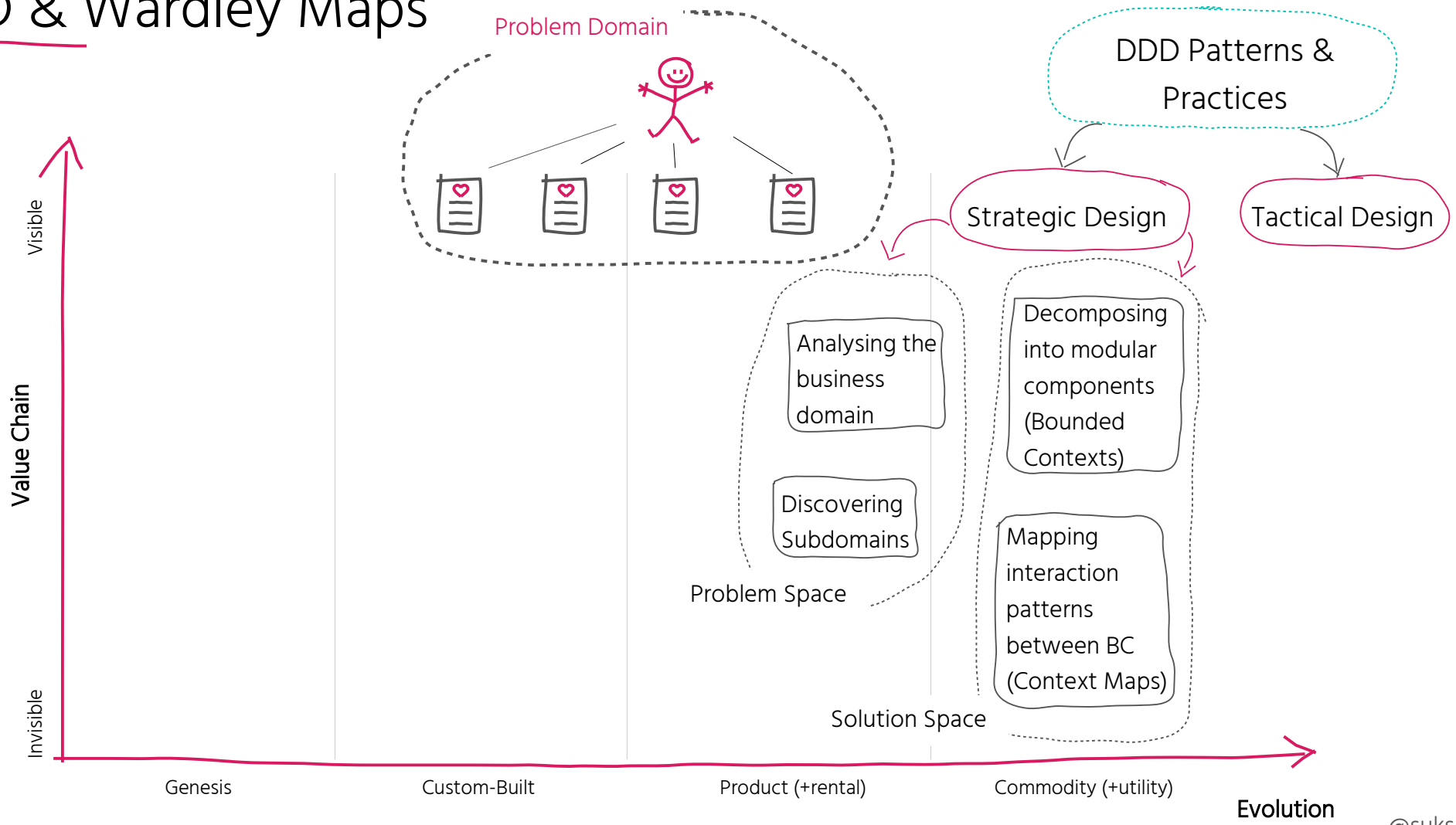
Custom-Built

Product (+rental)

Commodity (+utility)

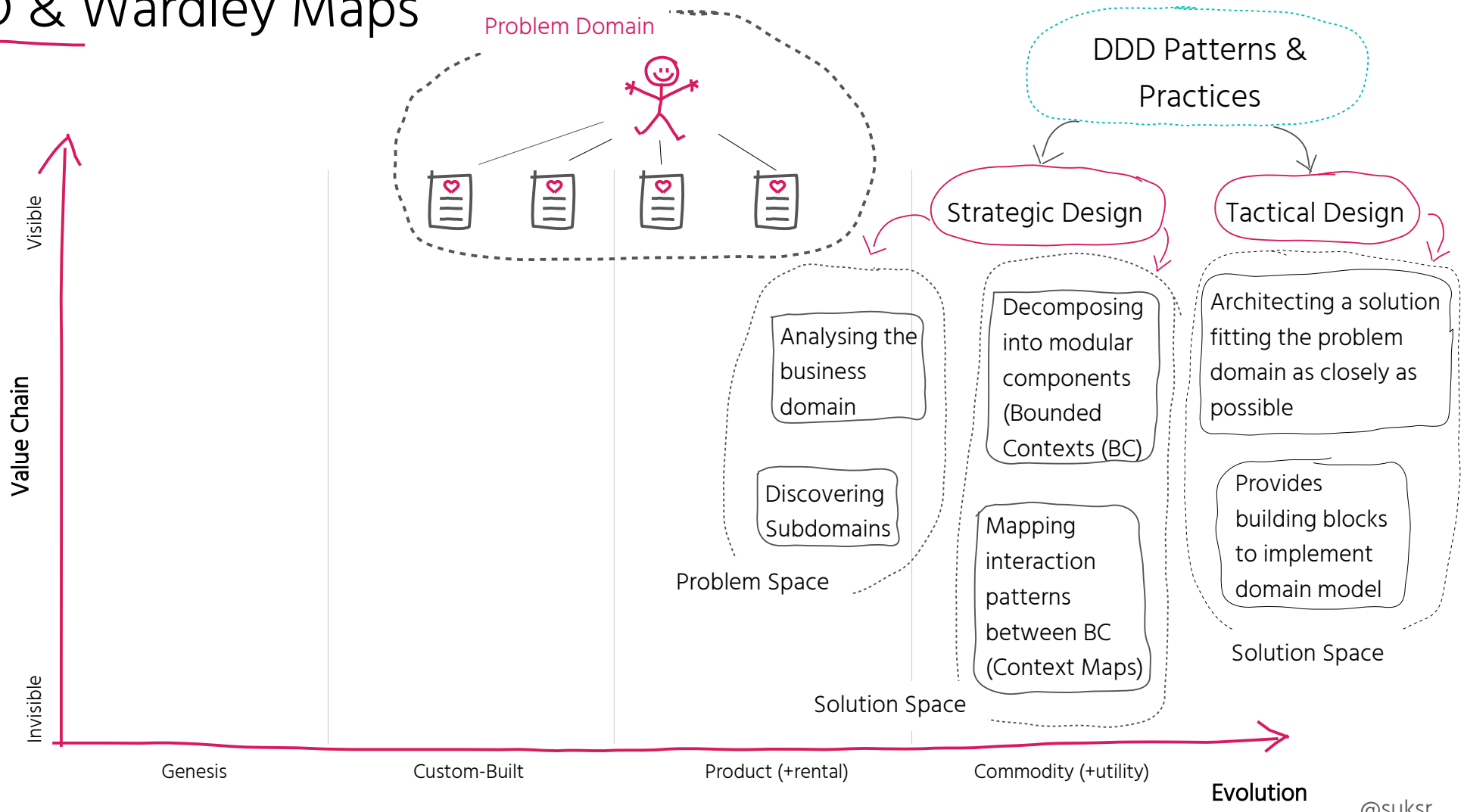
Evolution

DDD & Wardley Maps



@suksr

DDD & Wardley Maps



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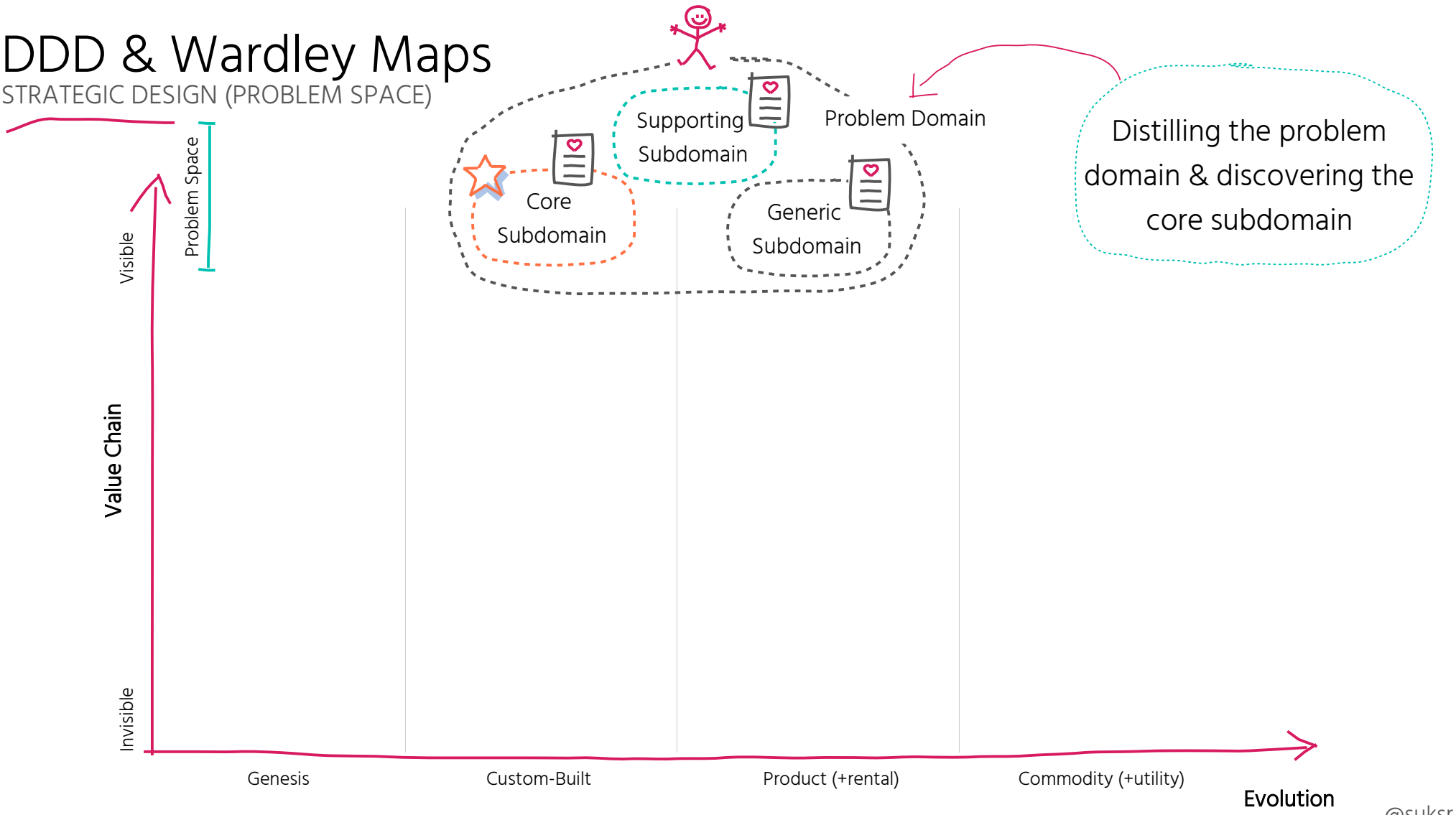
DDD & Wardley Maps

STRATEGIC DESIGN (PROBLEM SPACE)



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DDD & Wardley Maps

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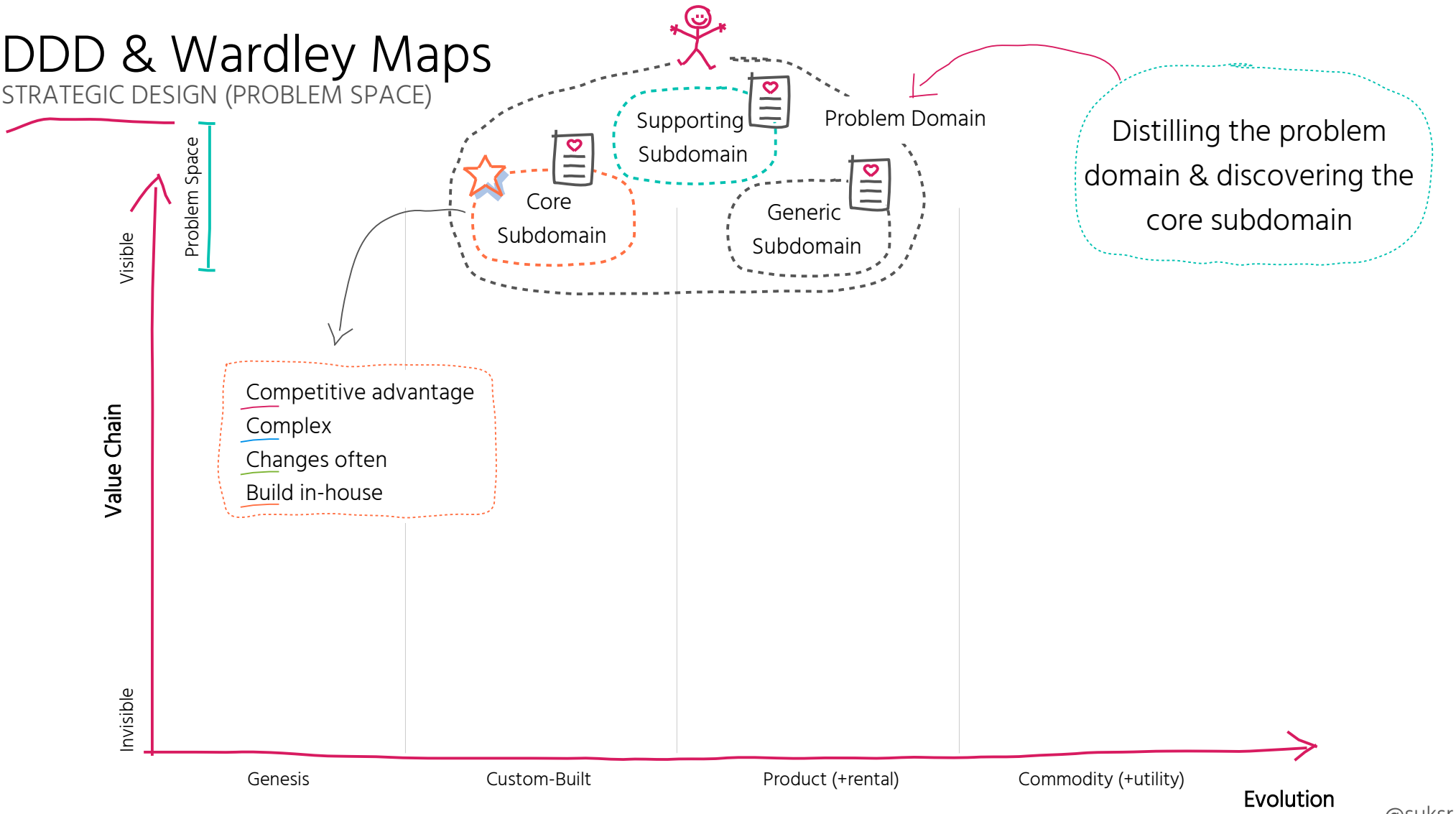

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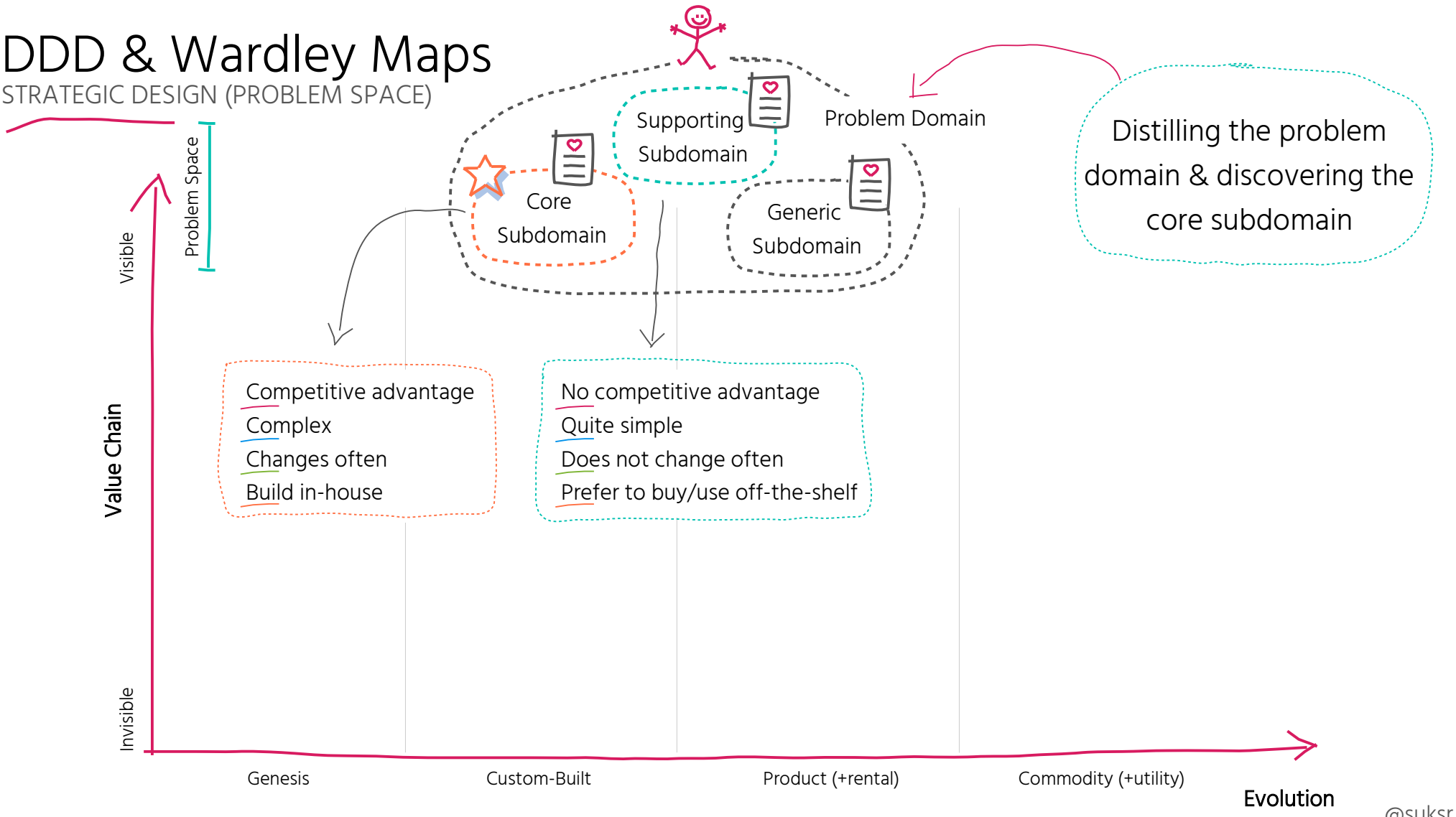

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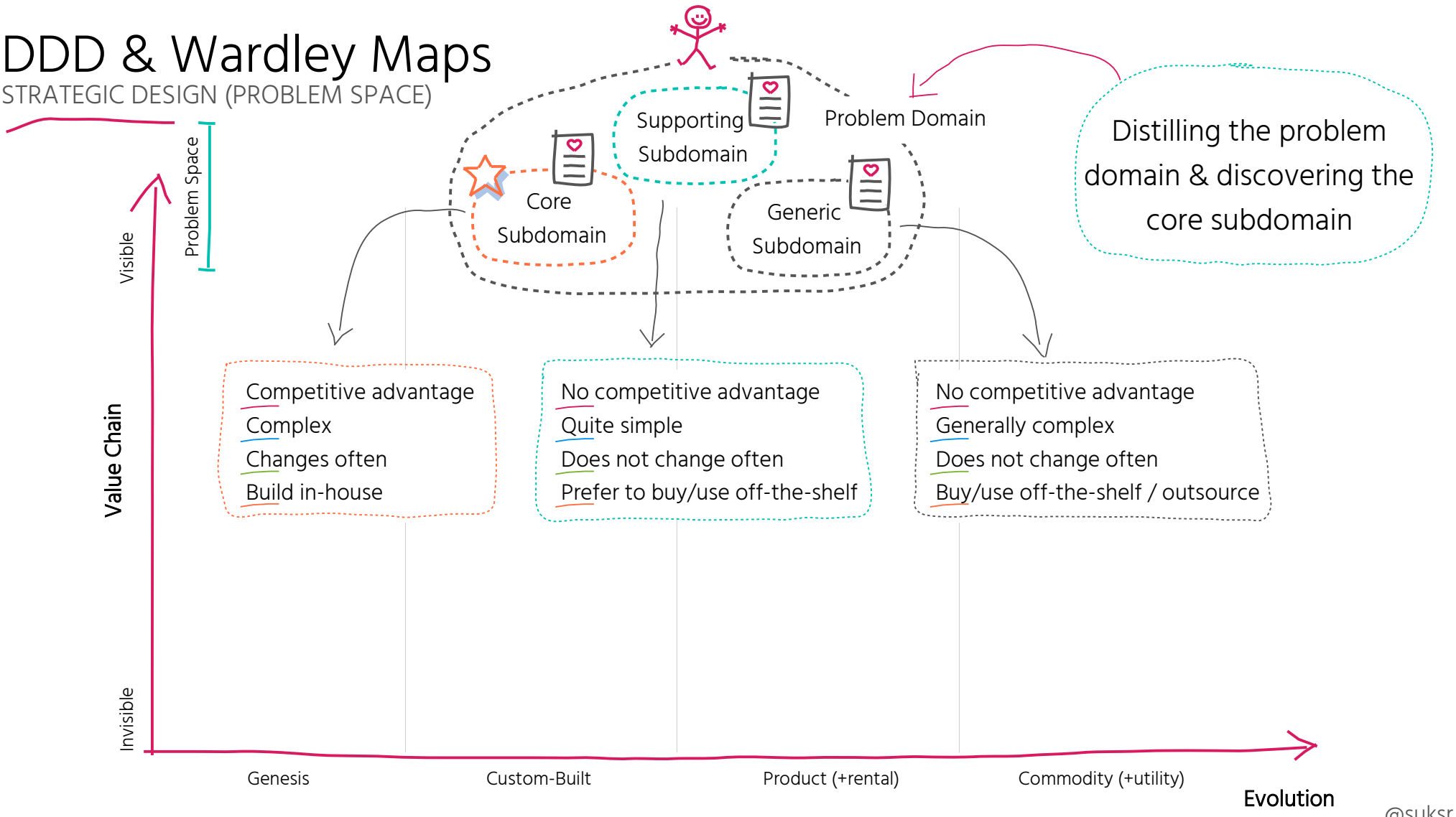
DDD & Wardley Maps

STRATEGIC DESIGN (PROBLEM SPACE)



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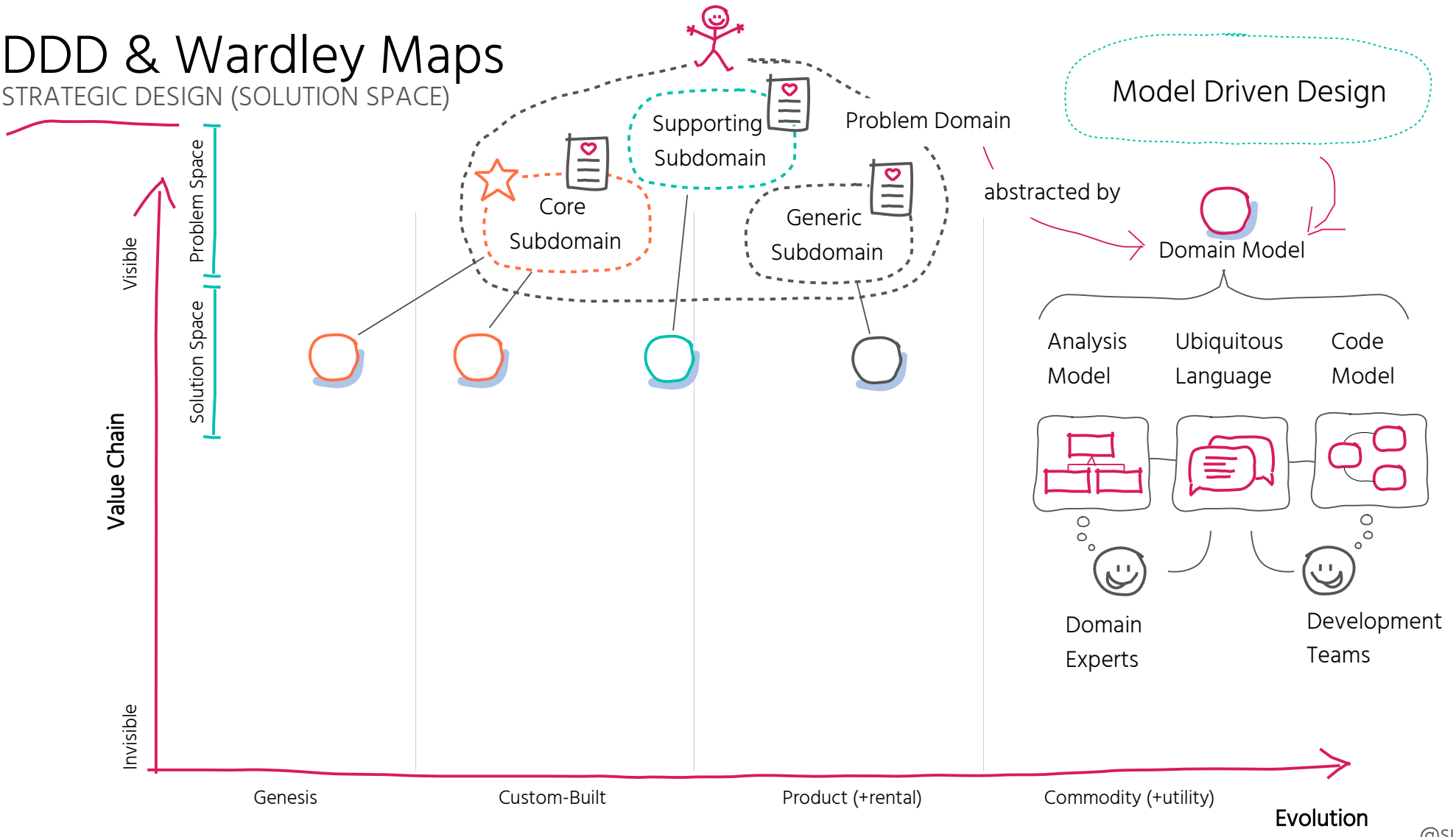
DDD & Wardley Maps

STRATEGIC DESIGN (SOLUTION SPACE)



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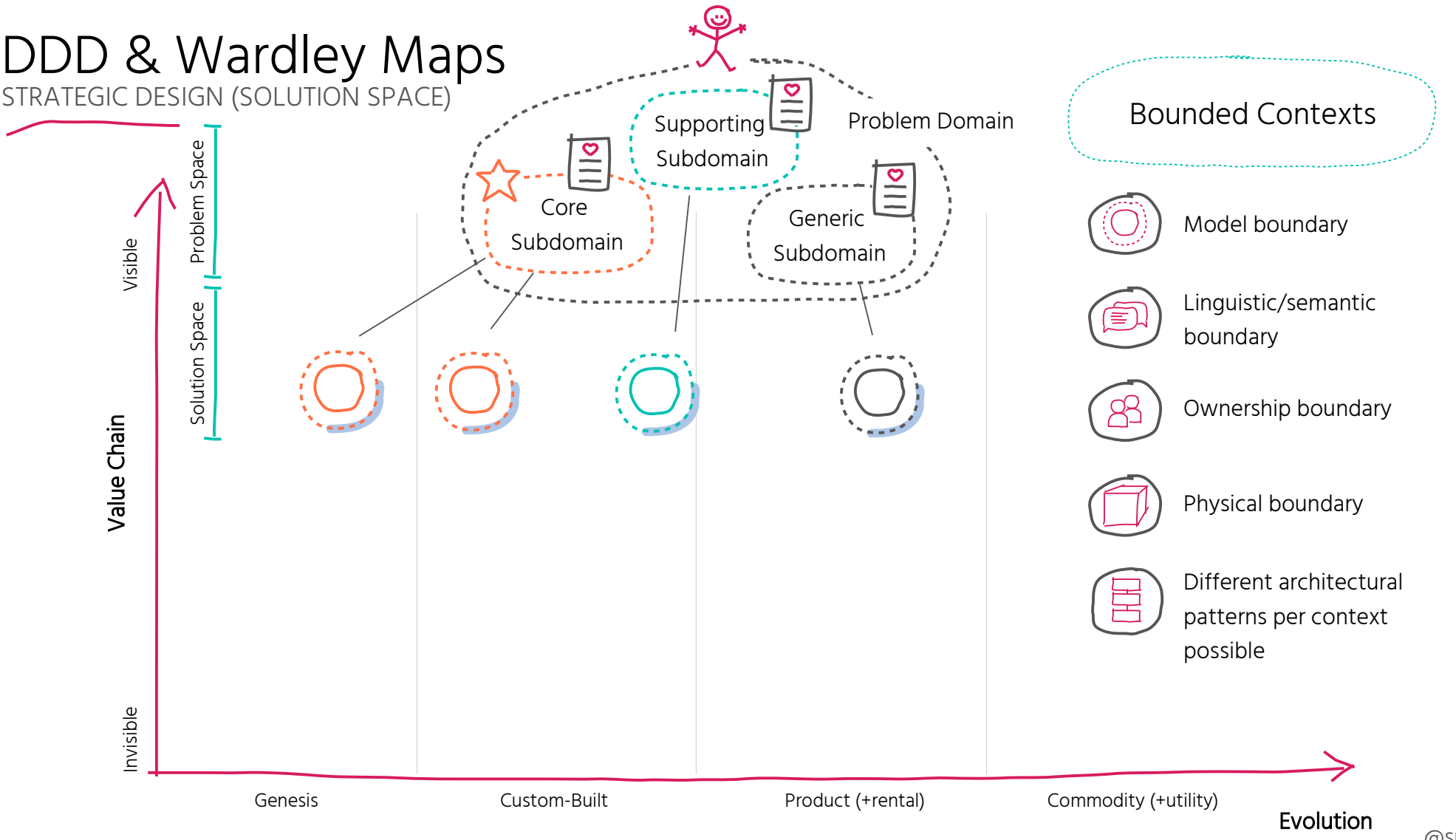
DDD & Wardley Maps

STRATEGIC DESIGN (SOLUTION SPACE)



Bounded Contexts

- Model boundary
- Linguistic/semantic boundary
- Ownership boundary
- Physical boundary
- Different architectural patterns per context possible

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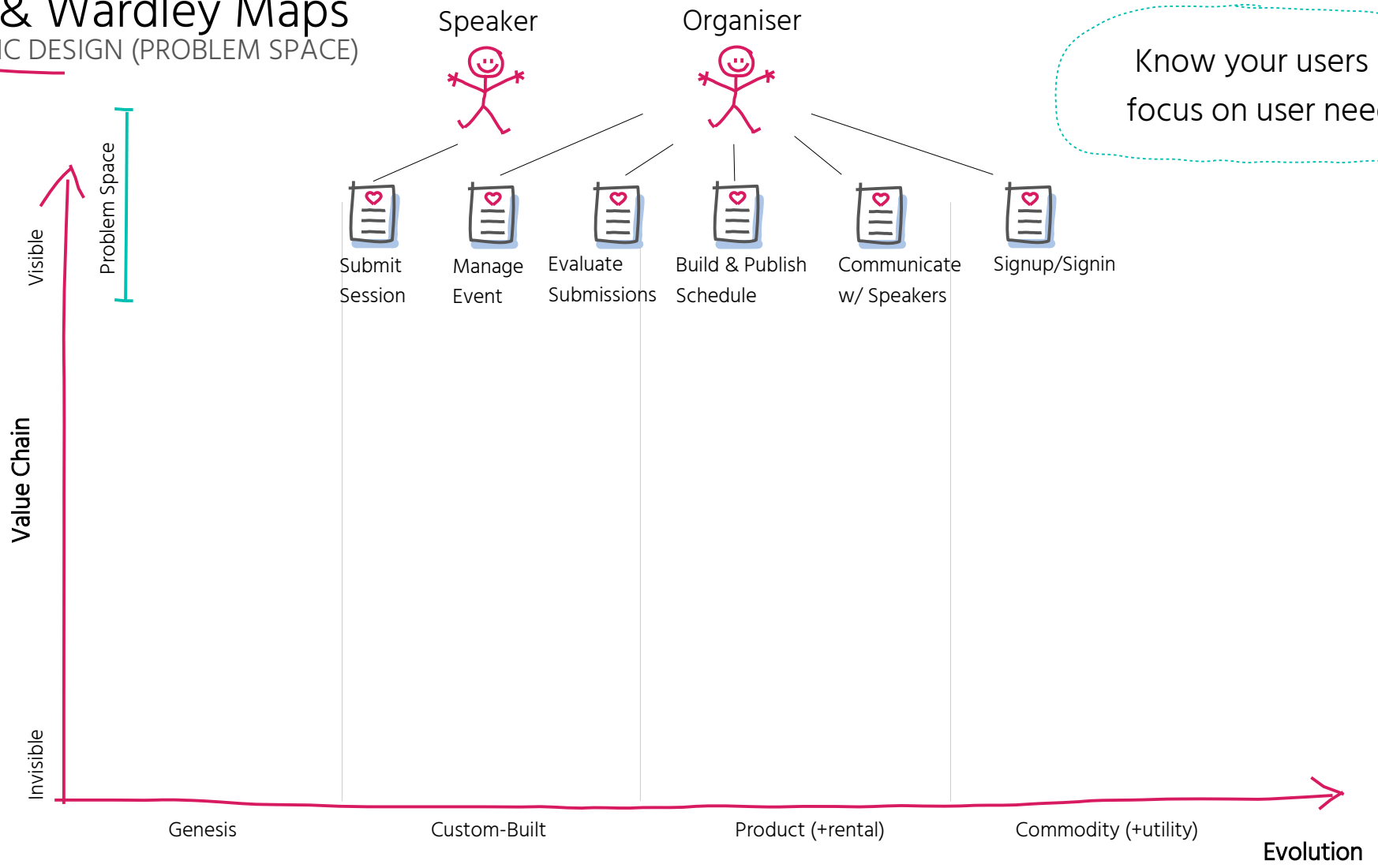
DDD & Wardley Maps

STRATEGIC DESIGN (PROBLEM SPACE)



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DDD & Wardley Maps

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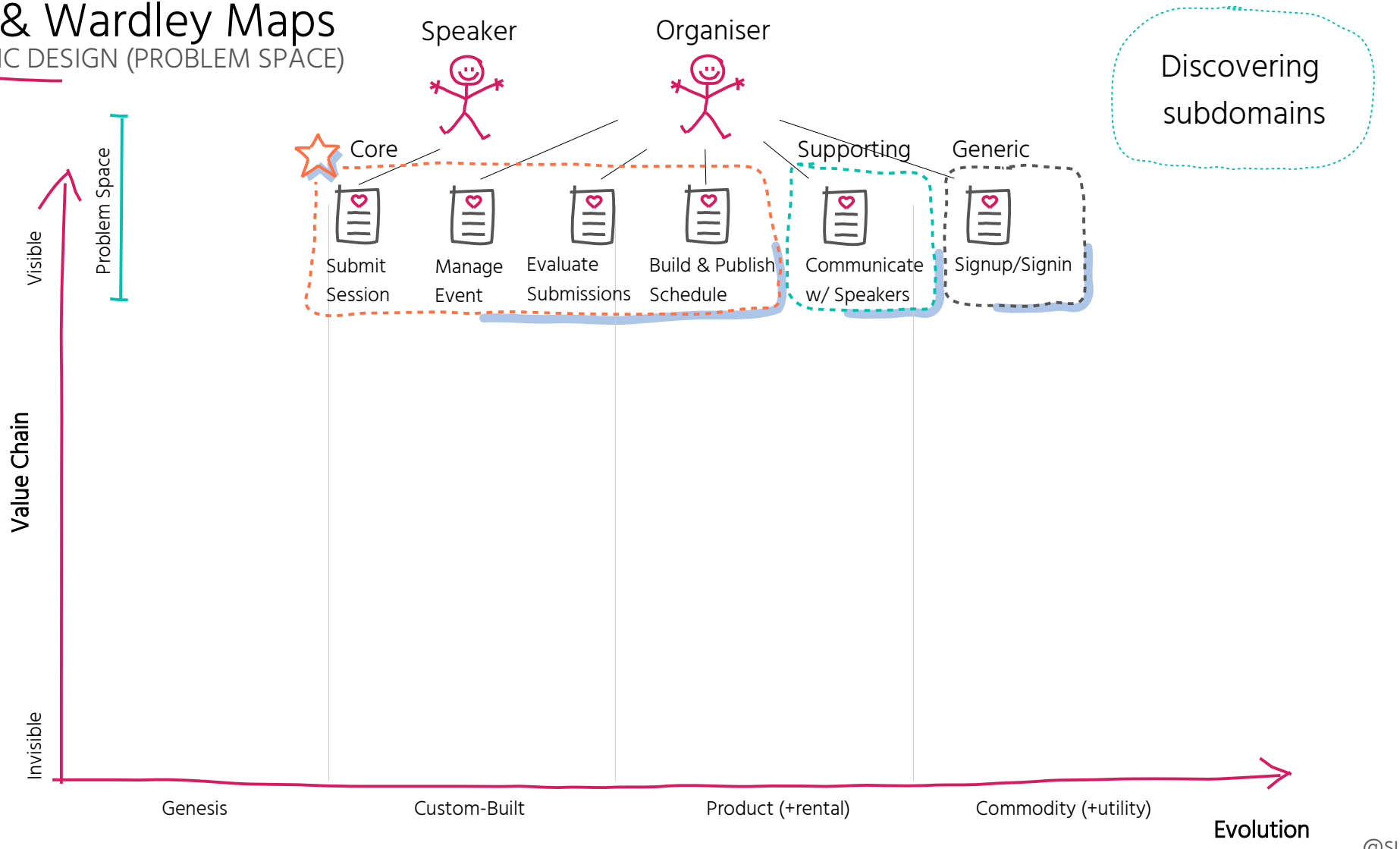
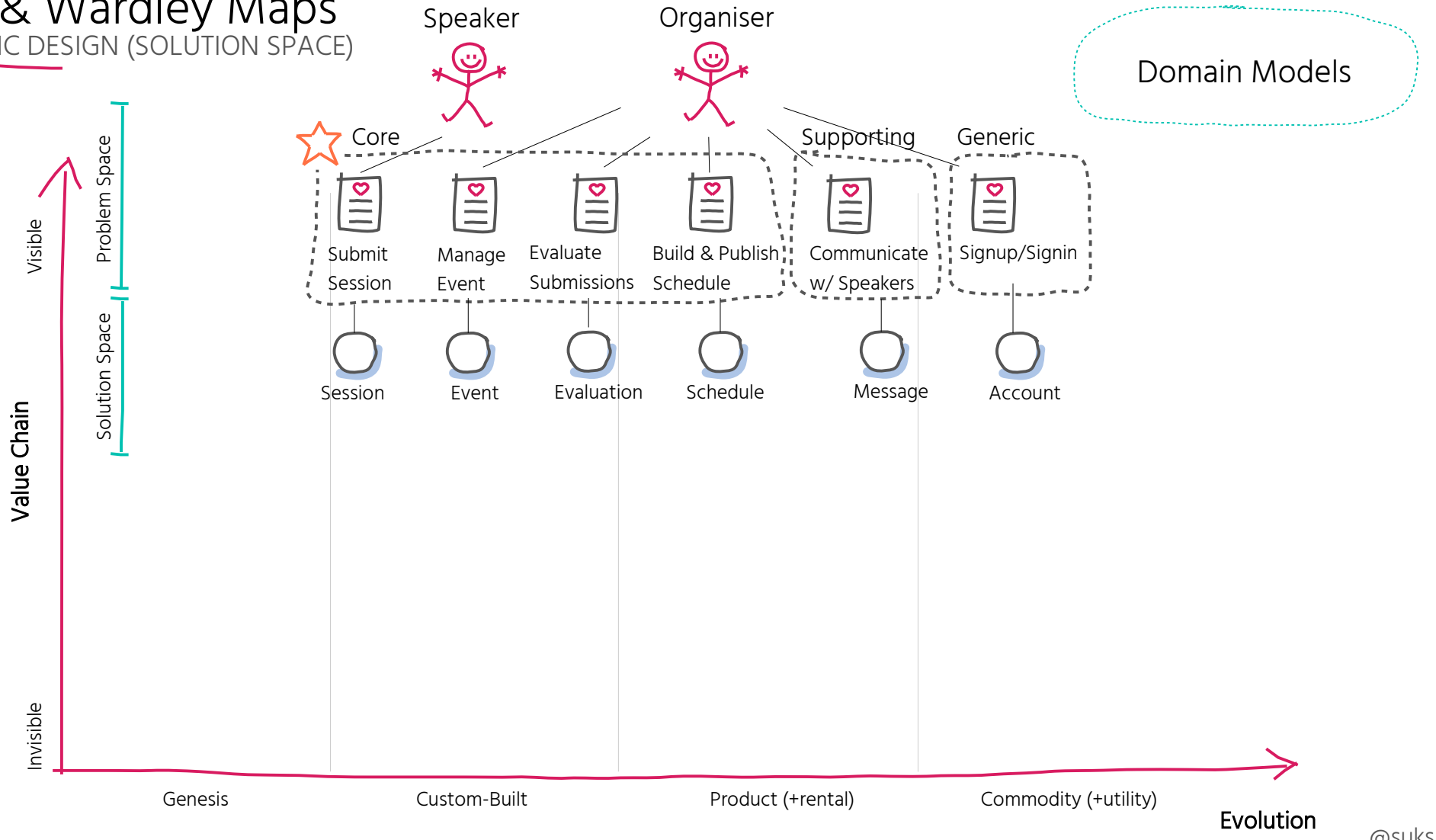


DDD & Wardley Maps

STRATEGIC DESIGN (SOLUTION SPACE)



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DDD & Wardley Maps

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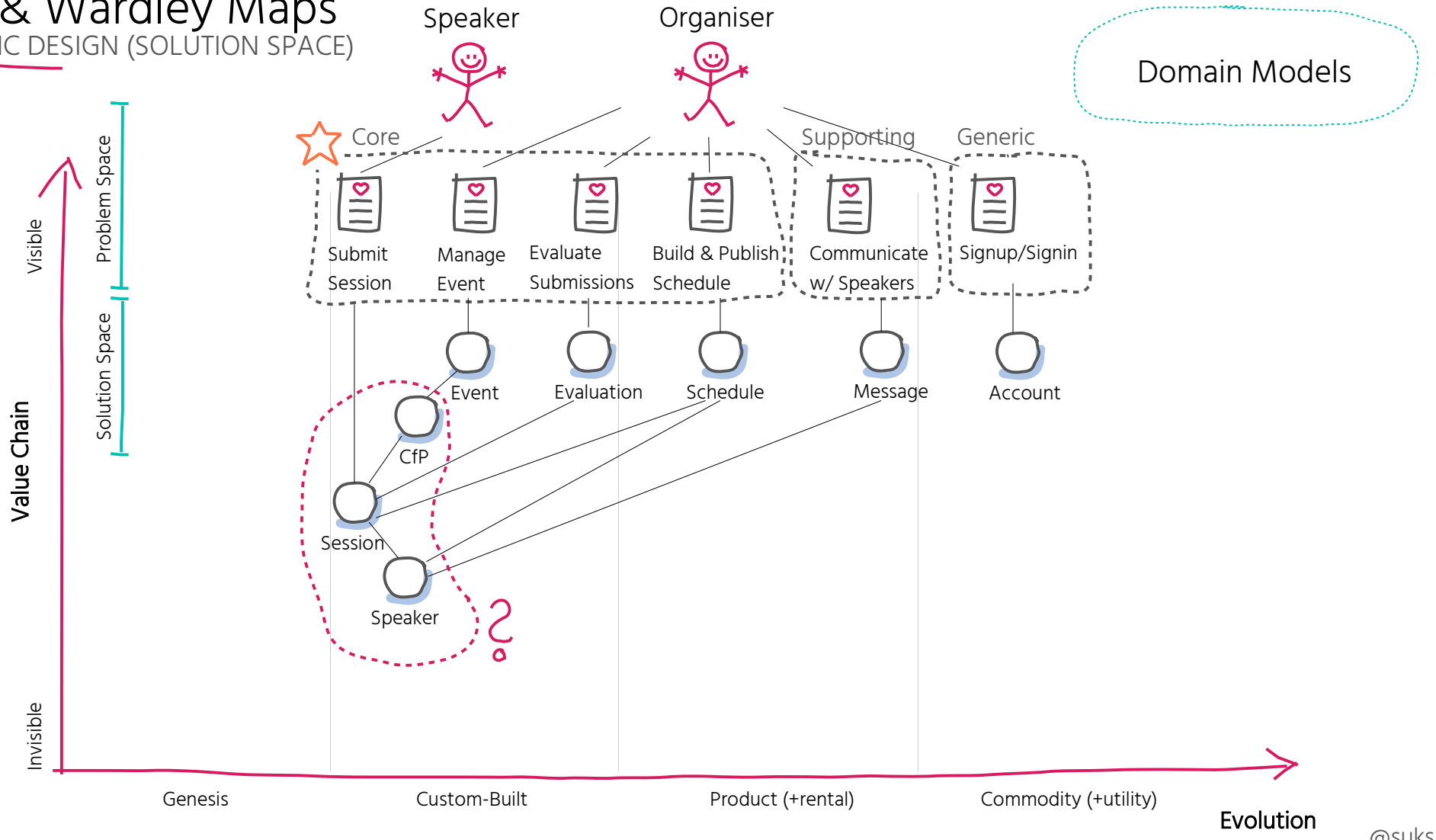

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DDD & Wardley Maps

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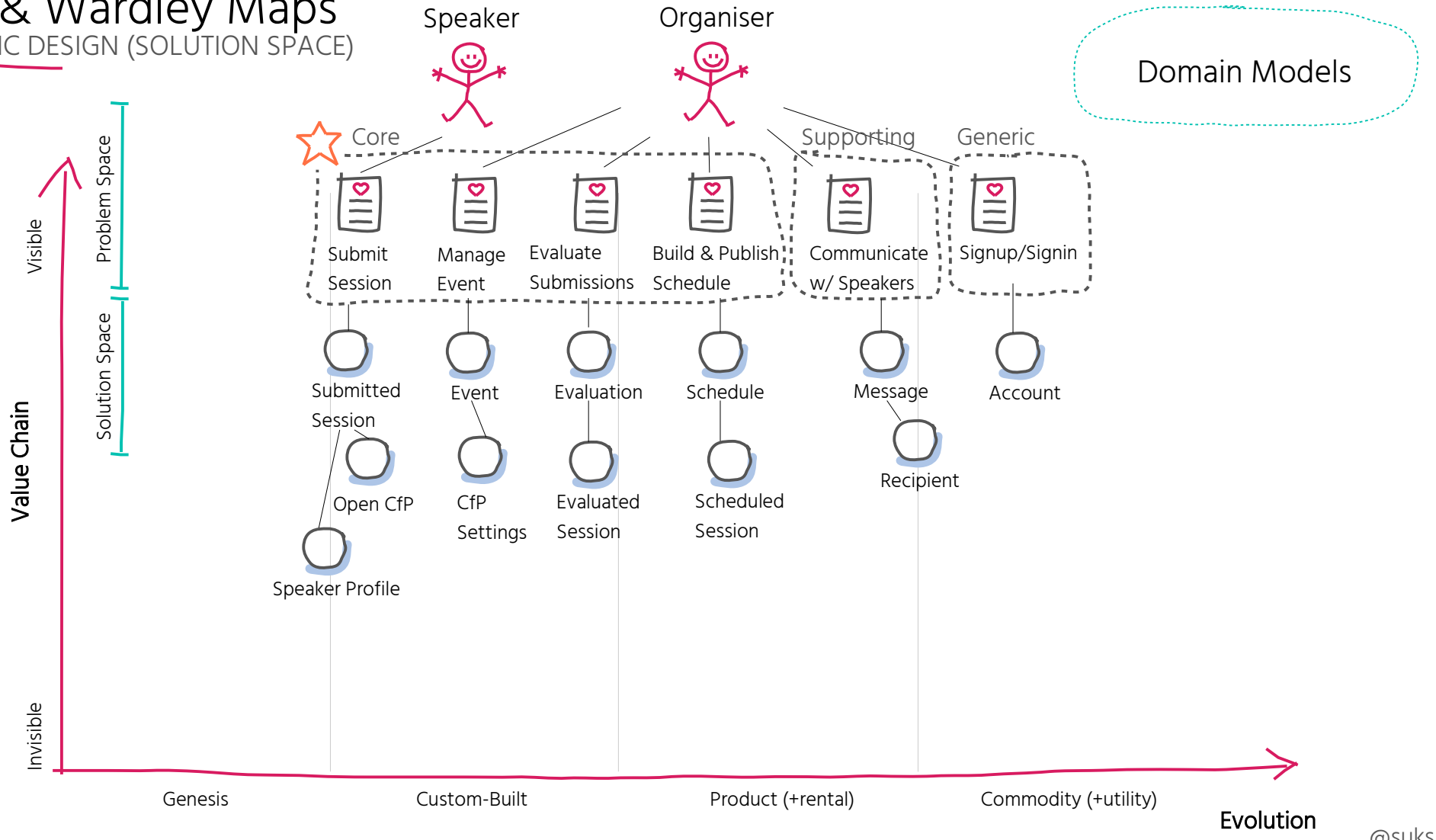

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DDD & Wardley Maps

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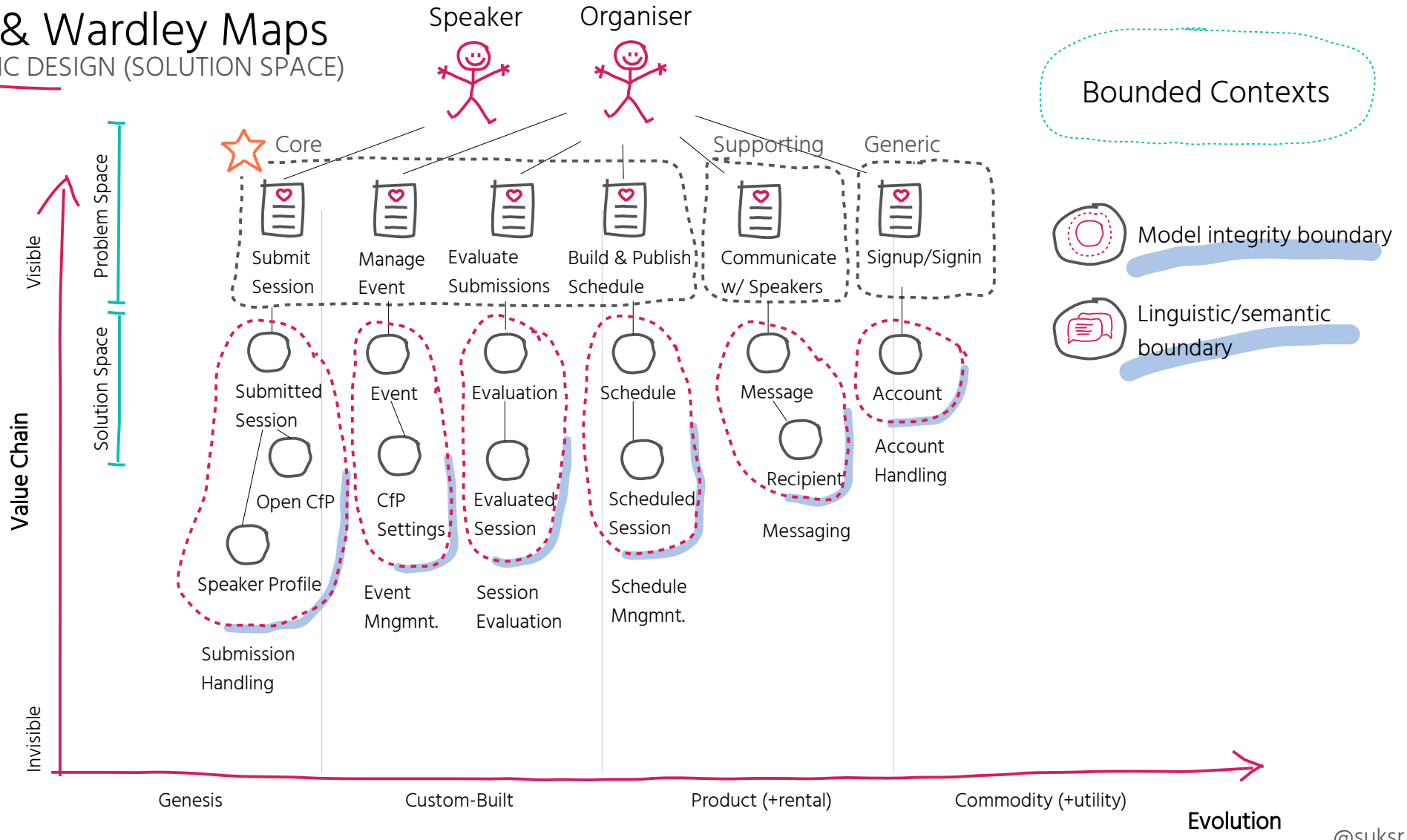

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DDD & Wardley Maps

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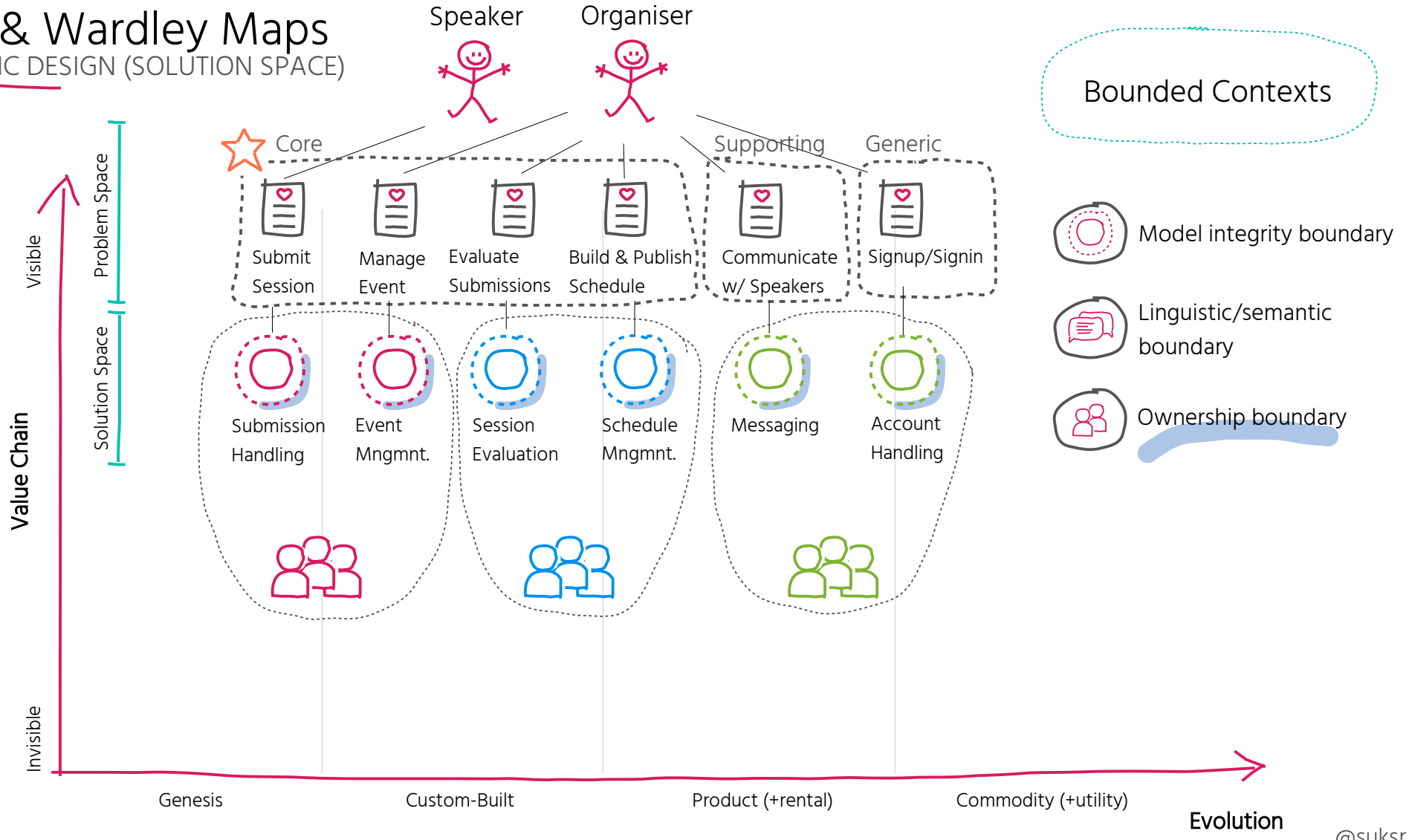

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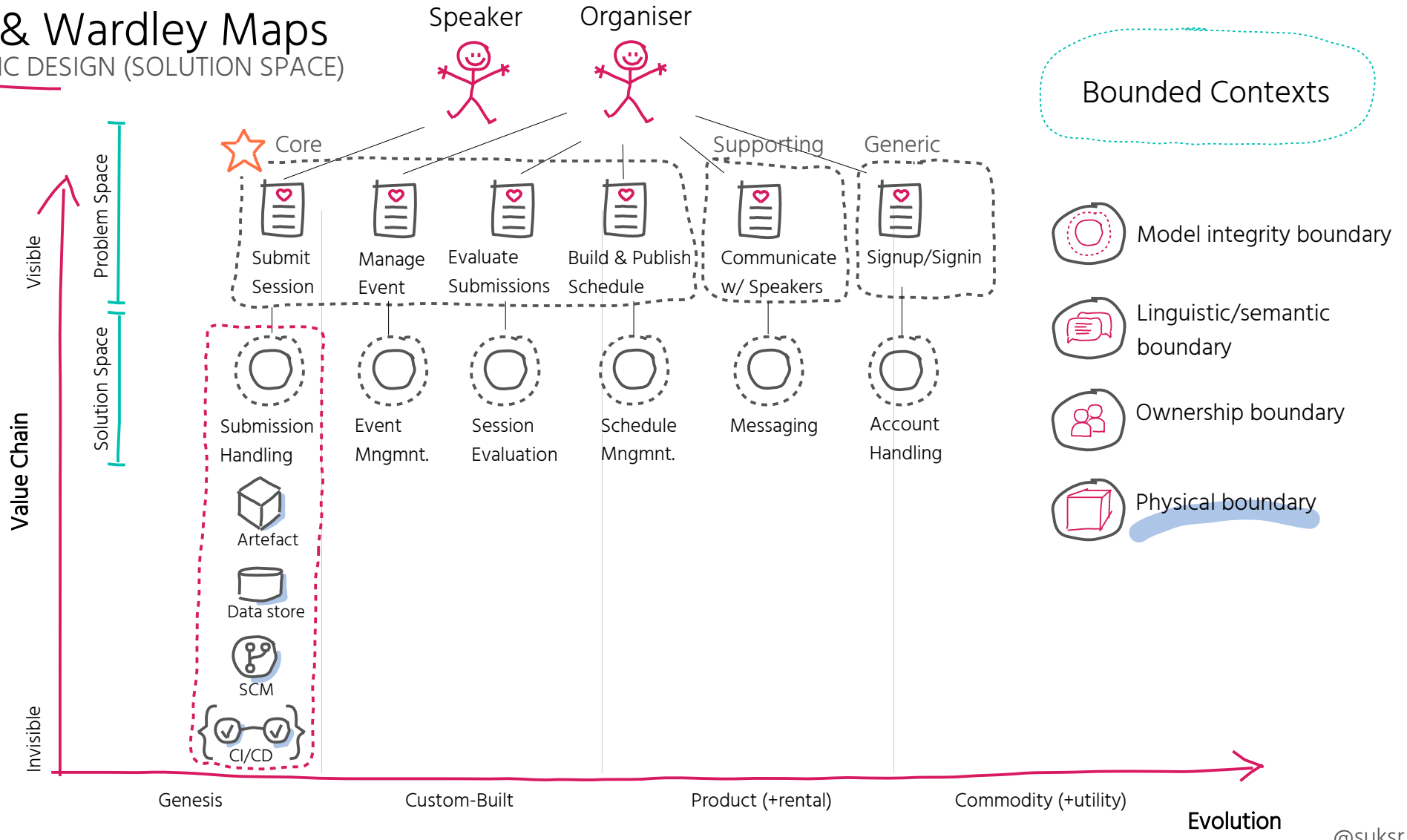
DDD & Wardley Maps

STRATEGIC DESIGN (SOLUTION SPACE)



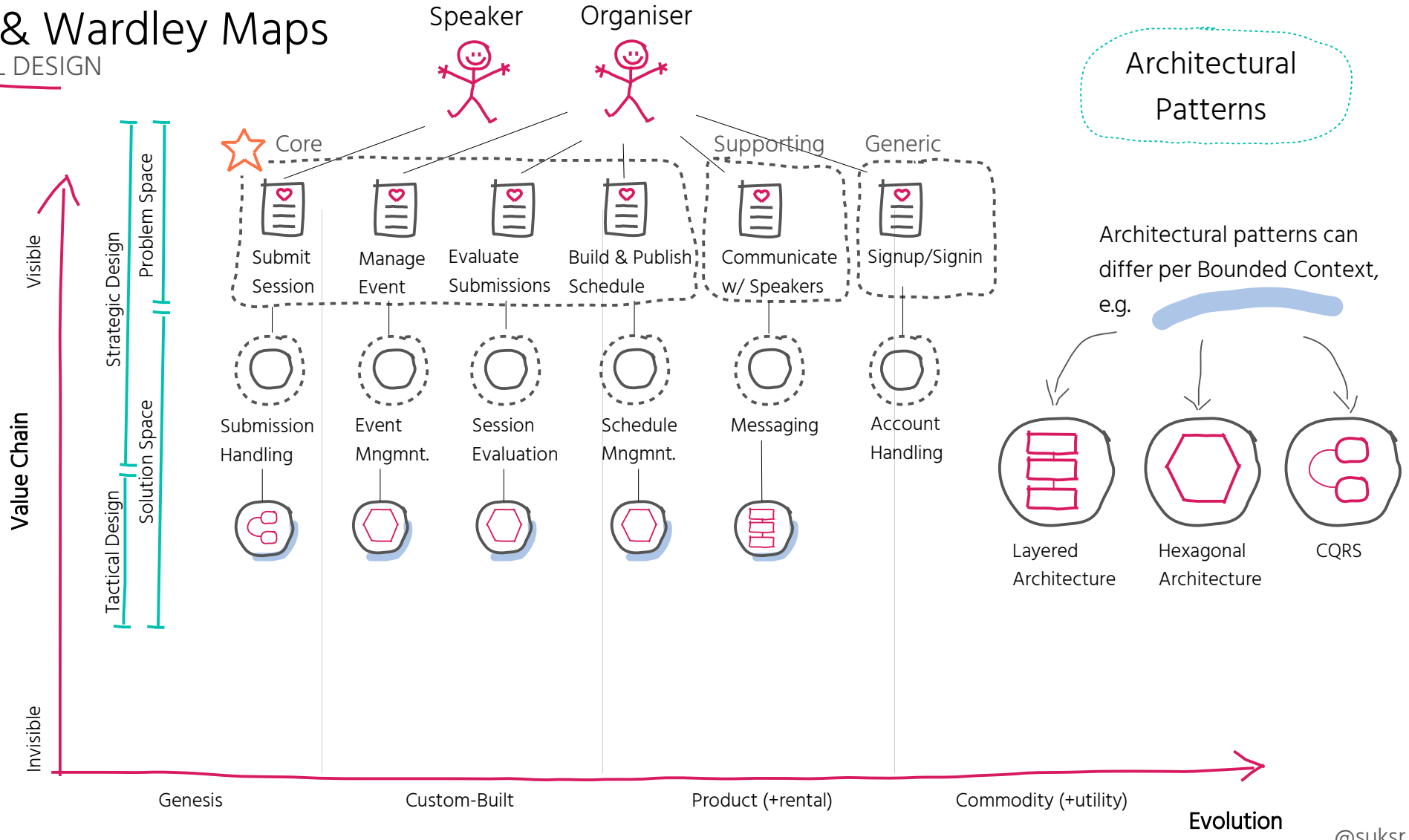
Bounded Contexts

- Model integrity boundary
- Linguistic/semantic boundary
- Ownership boundary
- Physical boundary

@suksr

DDD & Wardley Maps

TACTICAL DESIGN



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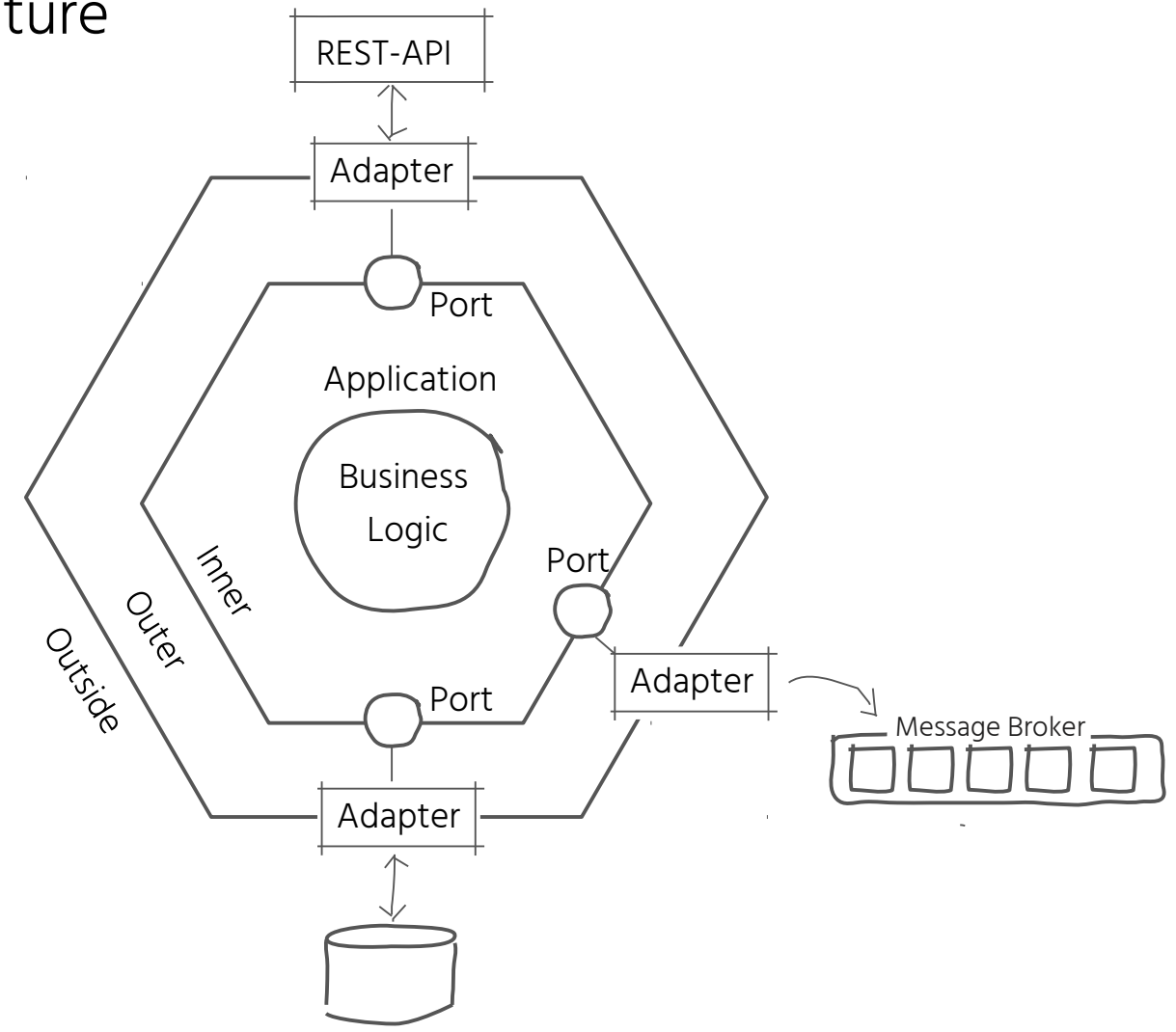
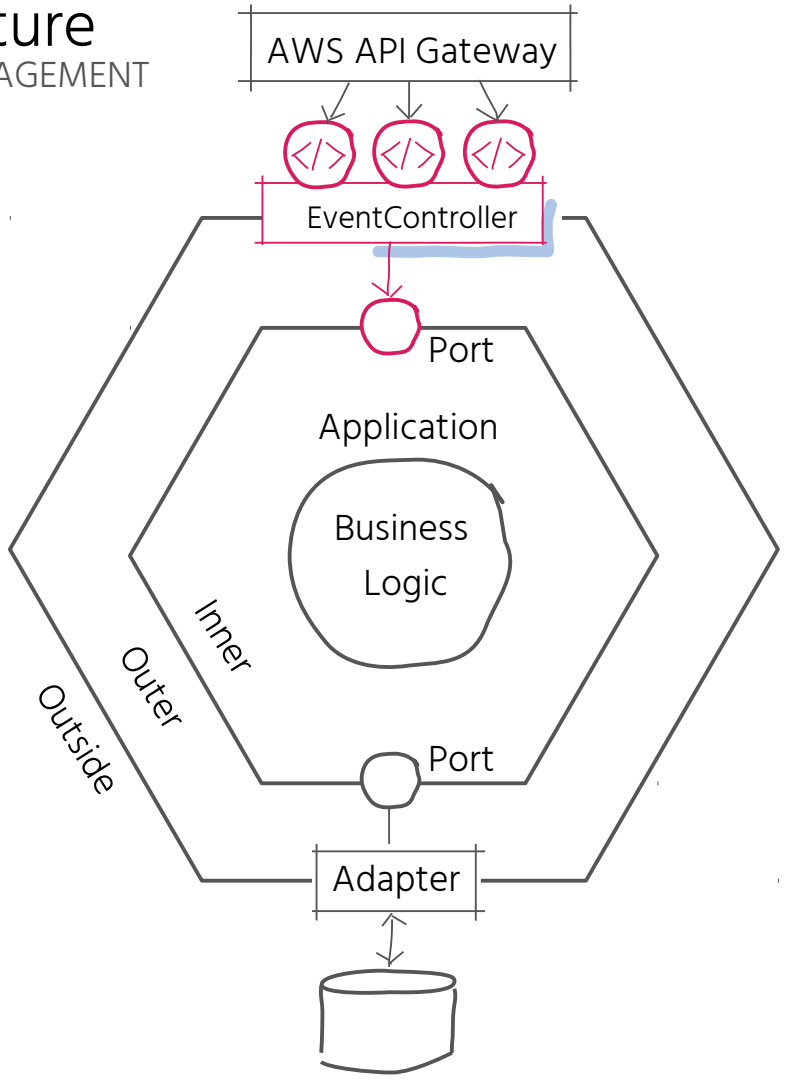
Hexagonal Architecture

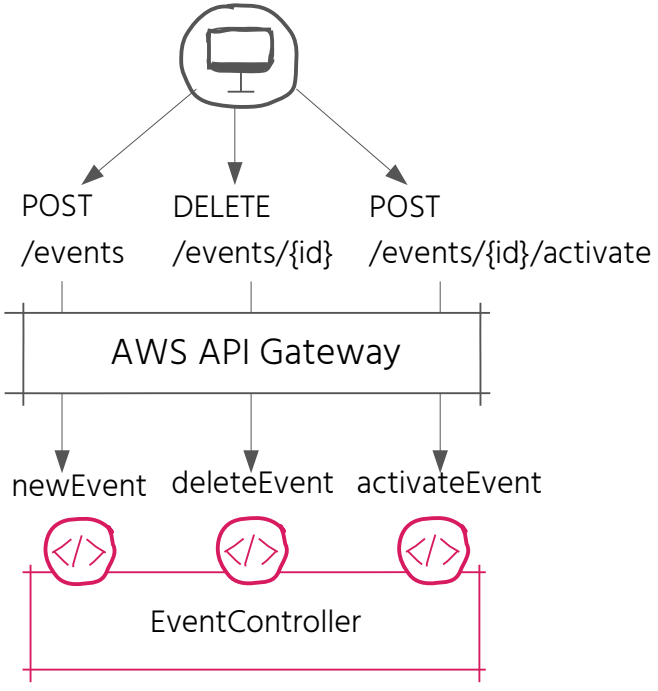


Hexagonal Architecture

BOUNDED CONTEXT: EVENT MANAGEMENT



REST-API with AWS API-Gateway and AWS Lambda



Hexagonal Architecture

BOUNDED CONTEXT: EVENT MANAGEMENT

REST-API Adapter

Port

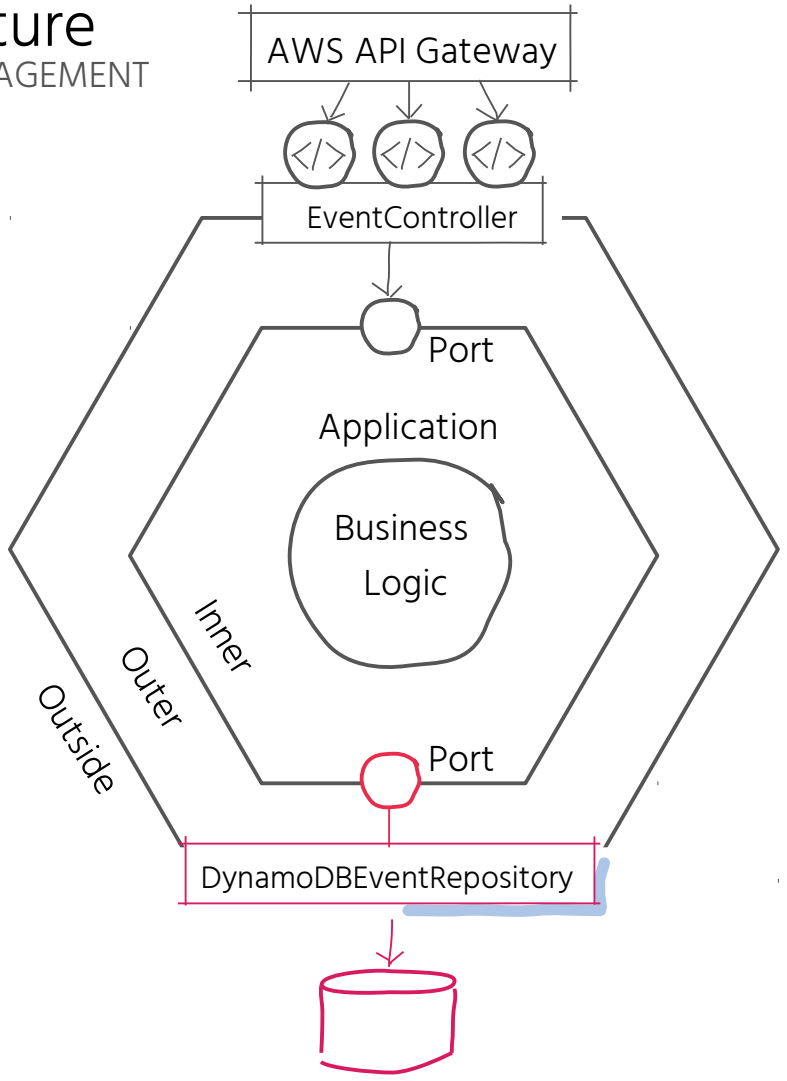
Lambda Function

Lambda Function

```
export class EventsController {

    private readonly  eventsService: EventApplicationService;

    public constructor(eventsService: EventApplicationService) {
        this.eventsService = eventsService;
    }

    public activateEvent: Handler = async (event: APIGatewayEvent, context: Context, callback: Callback) => {
        if (!event.pathParameters) {
            return callback(undefined, failure({ status: "error", error: "no event id specified" }));
        }
        if (!event.requestContext.authorizer) {
            return callback(undefined, failure({ status: "error", error: "no authorized user specified" }));
        }

        try {
            const eventId = new EventId(event.pathParameters.id);
            const userId = new UserId(event.requestContext.authorizer.claims['cognito:username']);

            await this.eventsService.activateEvent(eventId, userId);

            callback(undefined, success({status: "ok"}));
        } catch(e) {
            return callback(undefined, failure({ status: "error", error: e }));
        }
    };

    public newEvent: Handler = async (event: APIGatewayEvent, context: Context, callback: Callback) => {

        // ... //

}
```

Hexagonal Architecture

BOUNDED CONTEXT: EVENT MANAGEMENT



Data Storage with AWS DynamoDB

Hexagonal Architecture

BOUNDED CONTEXT: EVENT MANAGEMENT

```
export default class DynamoDBEventRepository implements EventRepository {

    private static TABLE_NAME: string = "events";
    private readonly dynamoDbClient: AWS.DynamoDB.DocumentClient;

    constructor() {
        this.dynamoDbClient = new AWS.DynamoDB.DocumentClient();
    }

    public async eventOfId(id: EventId): Promise<Event|null> {
        const params : DocumentClient.GetItemInput = {
            TableName: DynamoDBEventRepository.TABLE_NAME,
            Key: {
                eventId: id
            }
        };
        const result: DocumentClient.GetItemOutput = await this.dynamoDbClient.get(params).promise();
        const item: AttributeMap|undefined = result.Item;
        if (item) {
            const id = new EventId(item.eventId);
            const name = Name.create(item.name);
            const description = Description.create(item.description);
            const period = Period.create(item.period.startDate, item.period.endDate);

            return Event.create(id, name, item.eventStatus, period, description);
        }
        return null;
    }

    public saveEvent(event: Event) {
        const params : DocumentClient.PutItemInput = {
            // ... //
        };

        return this.dynamoDbClient.put(params).promise();
    }
}
```

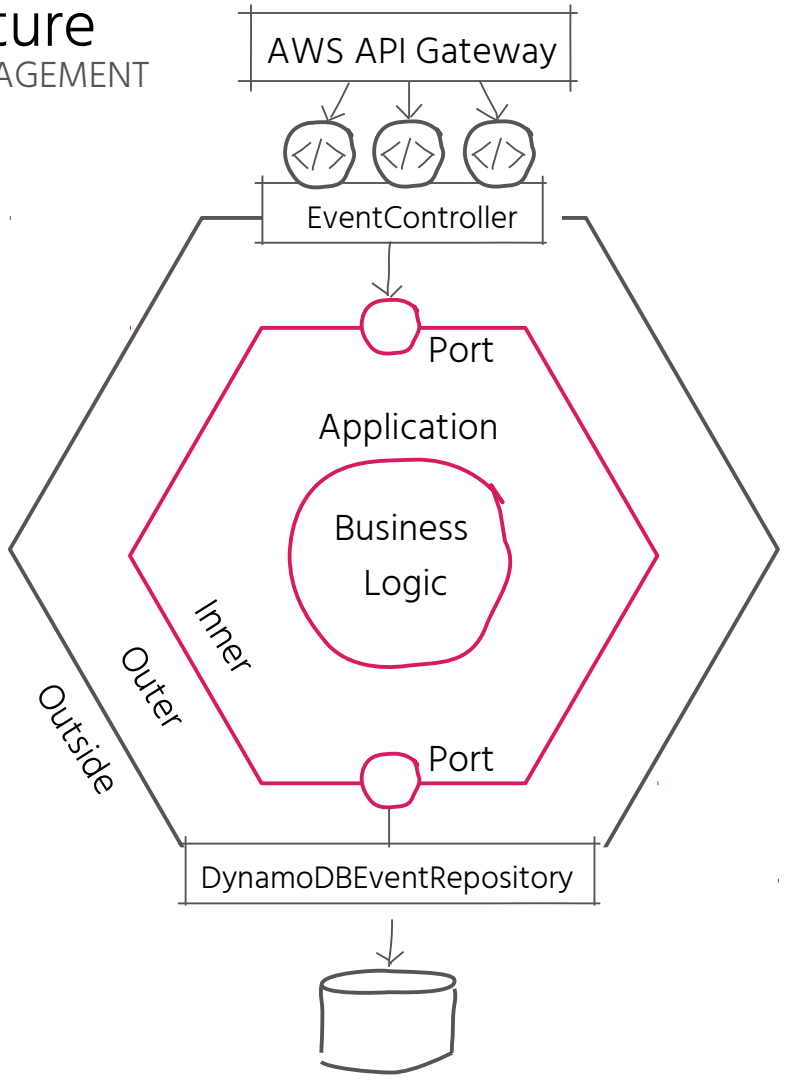
Port

DynamoDB Client

Database Adapter

Hexagonal Architecture

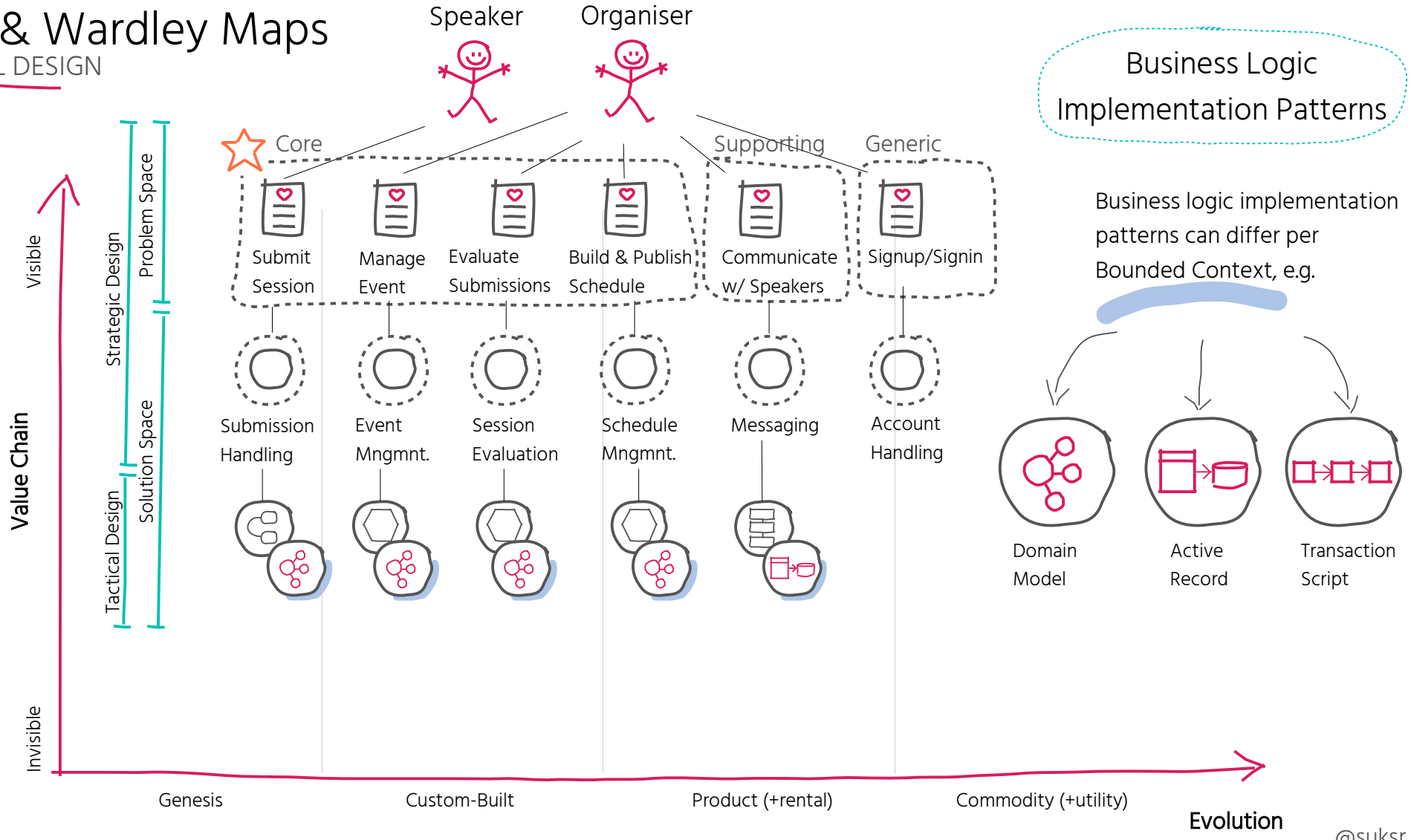
BOUNDED CONTEXT: EVENT MANAGEMENT



Business Logic Implementation

DDD & Wardley Maps

TACTICAL DESIGN



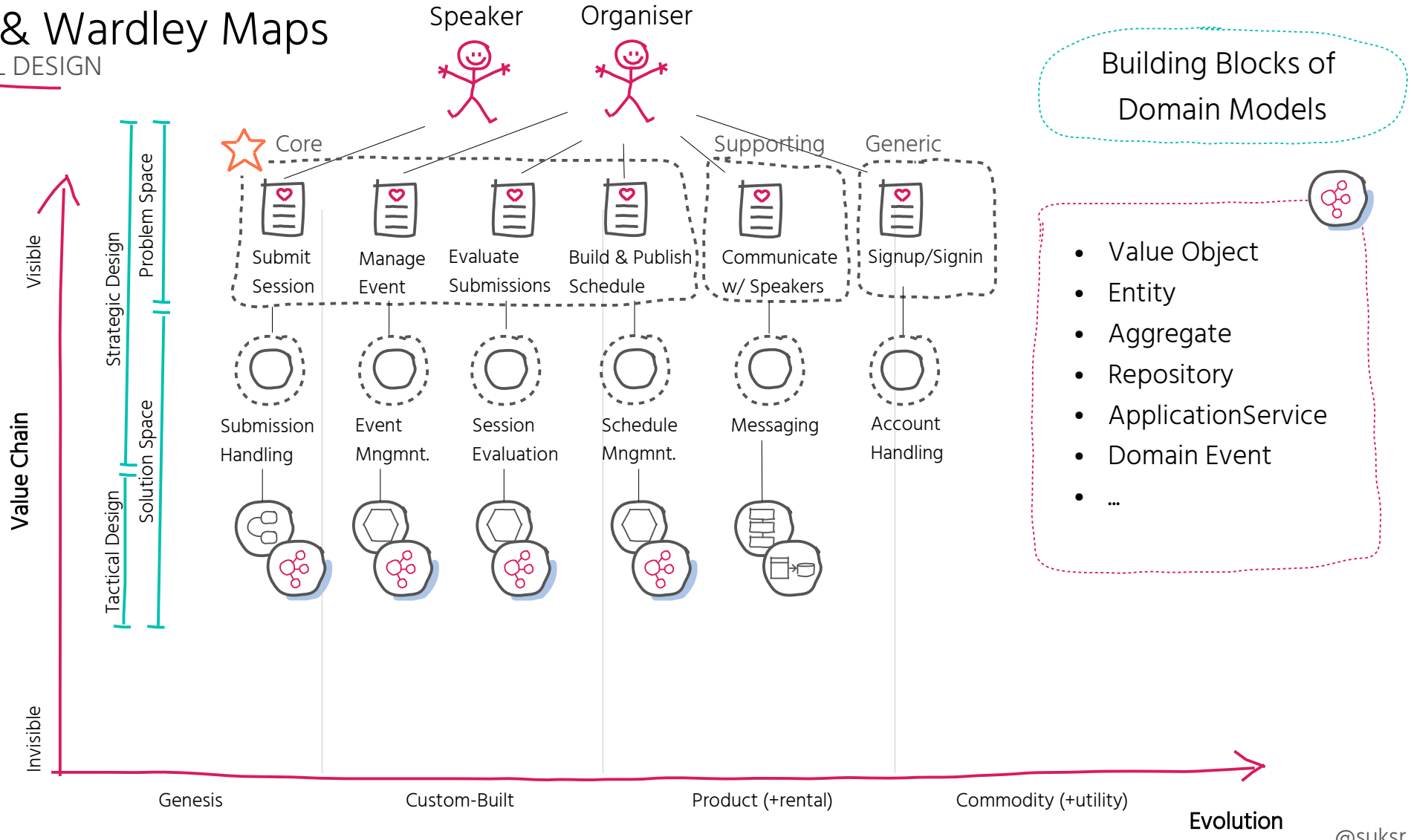
Business Logic Implementation Patterns

Business logic implementation patterns can differ per Bounded Context, e.g.

@suksr

DDD & Wardley Maps

TACTICAL DESIGN



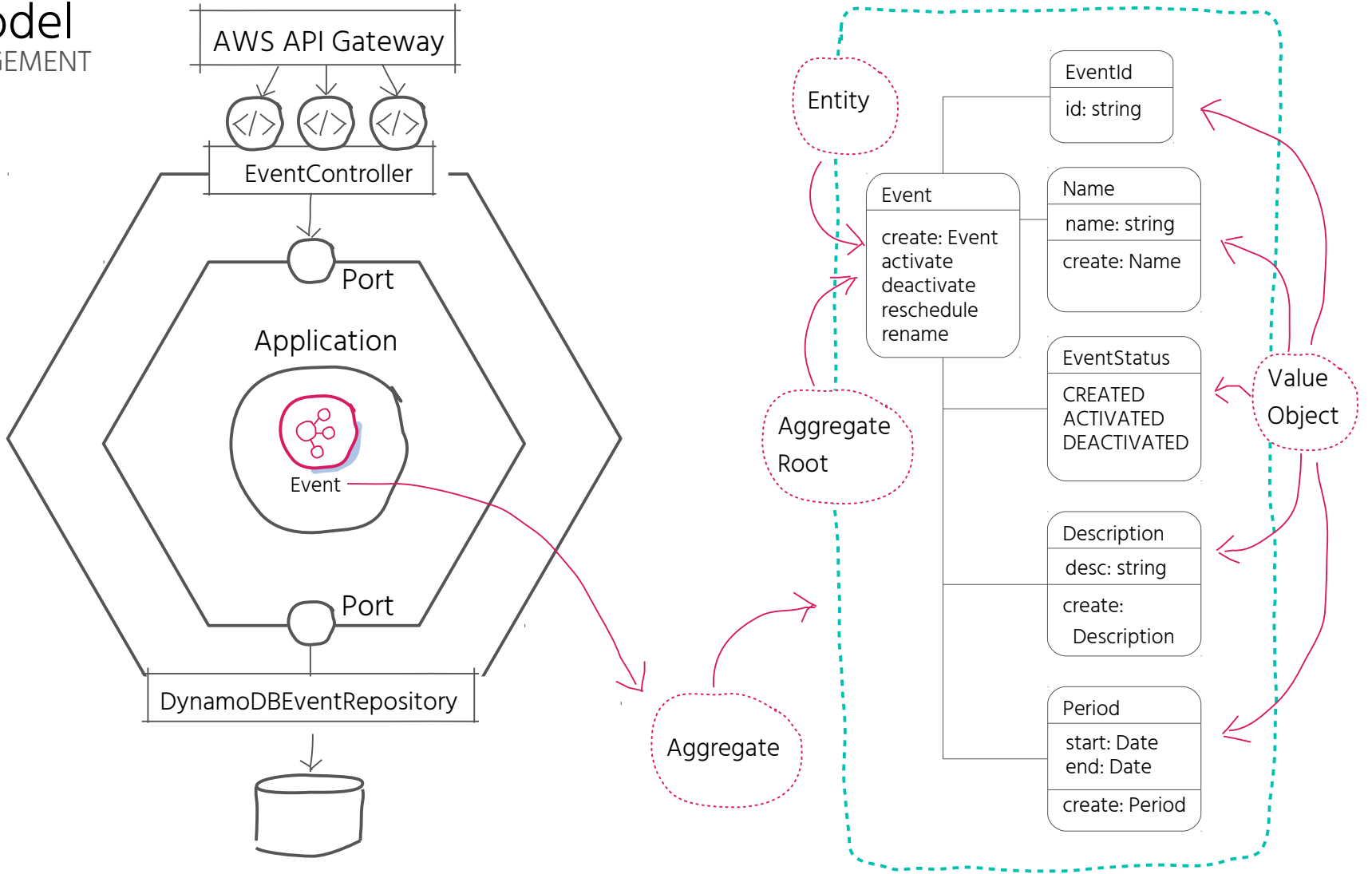
Building Blocks of Domain Models

- Value Object
- Entity
- Aggregate
- Repository
- ApplicationService
- Domain Event
- …

@suksr

Domain Model

BC: EVENT MANAGEMENT

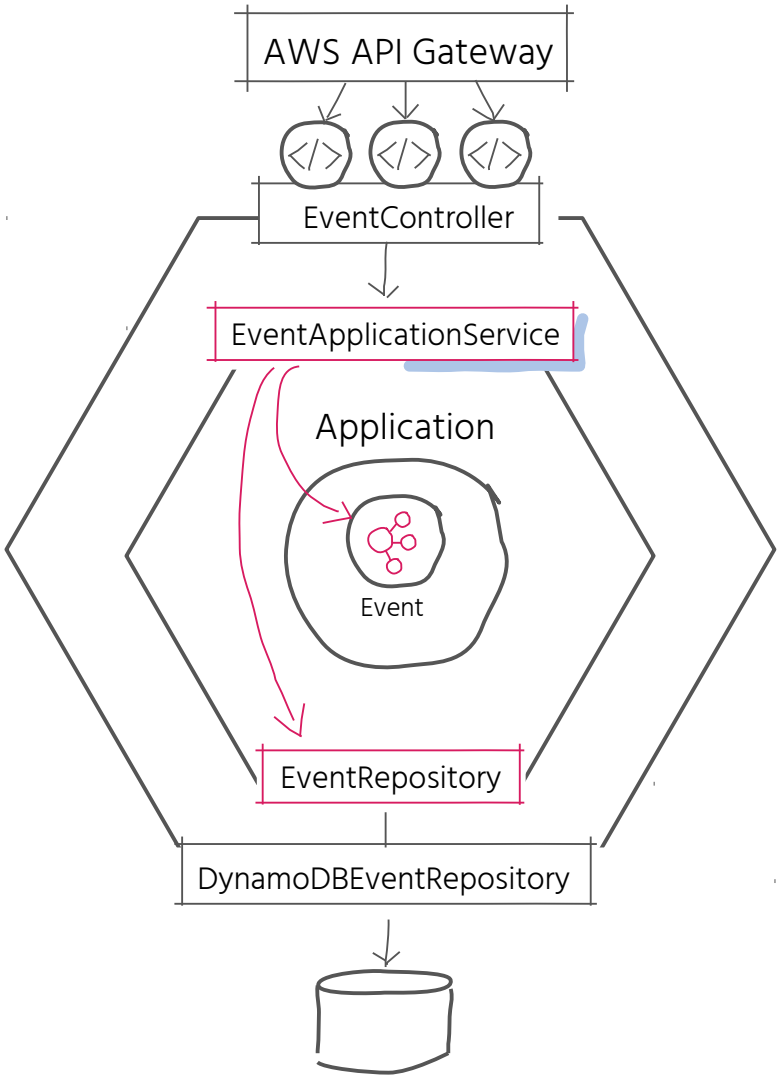


```ts
export default class Event {

    readonly id: EventId;
    name: Name;
    description?: Description;
    status: EventStatus;
    period: Period;

    private constructor(id: EventId, name: Name, status: EventStatus, period: Period, description?: Description) {
        this.id = id;
        this.name = name;
        this.description = description;
        this.status = status;
        this.period = period;
    }

    public activate() {
        if (this.status === EventStatus.CLOSED) {
            throw new Error("You cannot activate a closed event");
        }
        if (this.status === EventStatus.ACTIVATED) {
            throw new Error("This event has already been activated");
        }
        this.status = EventStatus.ACTIVATED;
    }

    public rename(name: Name) {
        if (!name) {
            throw new Error("You cannot rename the event to an empty name");
        }
        this.name = name;
    }

    // ... //
}
```

Aggregate

Domain Model

BC: EVENT MANAGEMENT



Domain Model

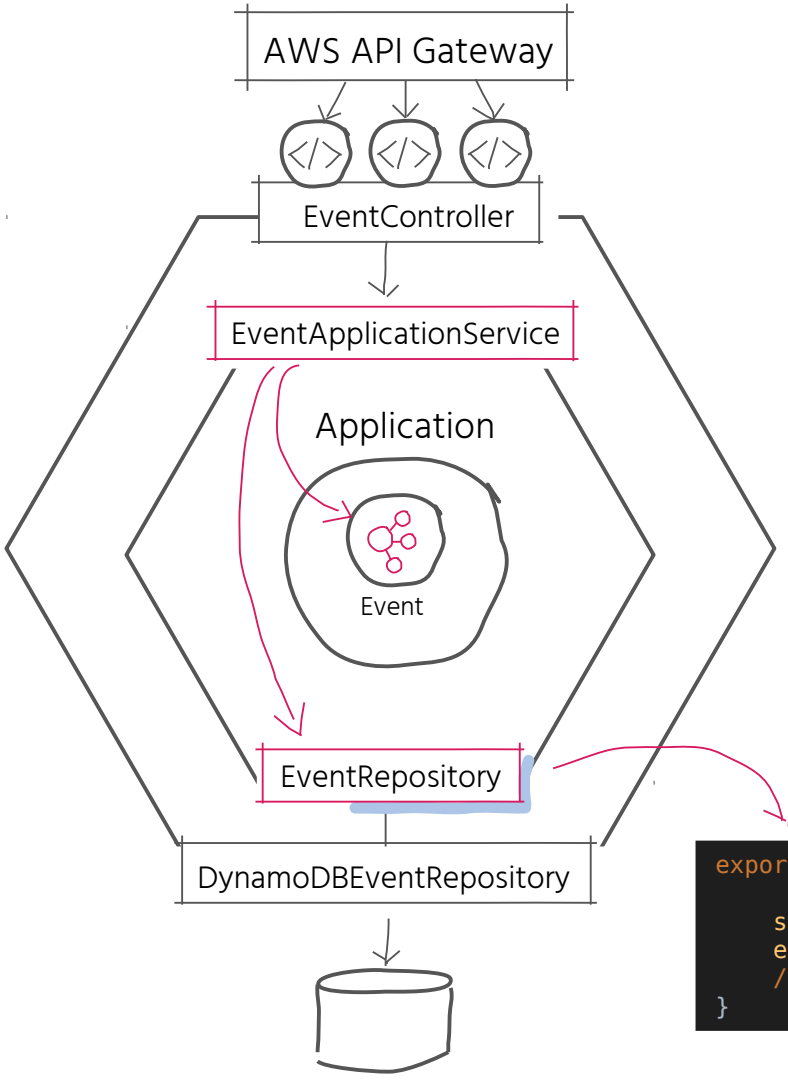
EVENT MANAGEMENT

ApplicationService

```
export default class EventApplicationService {

    private readonly eventRepository: EventRepository;

    constructor(eventRepository: EventRepository) {
        this.eventRepository = eventRepository;
    }

    public async activateEvent(id: EventId) {

        const event = await this.eventRepository.eventOfId(id);
        if (!event) {
            throw new Error("Could not deactivate event with id " + id + ", since event does not exist.");
        }
        event.activate();
        await this.eventRepository.saveEvent(event);
    }

    // ... //

}
```

Domain Model

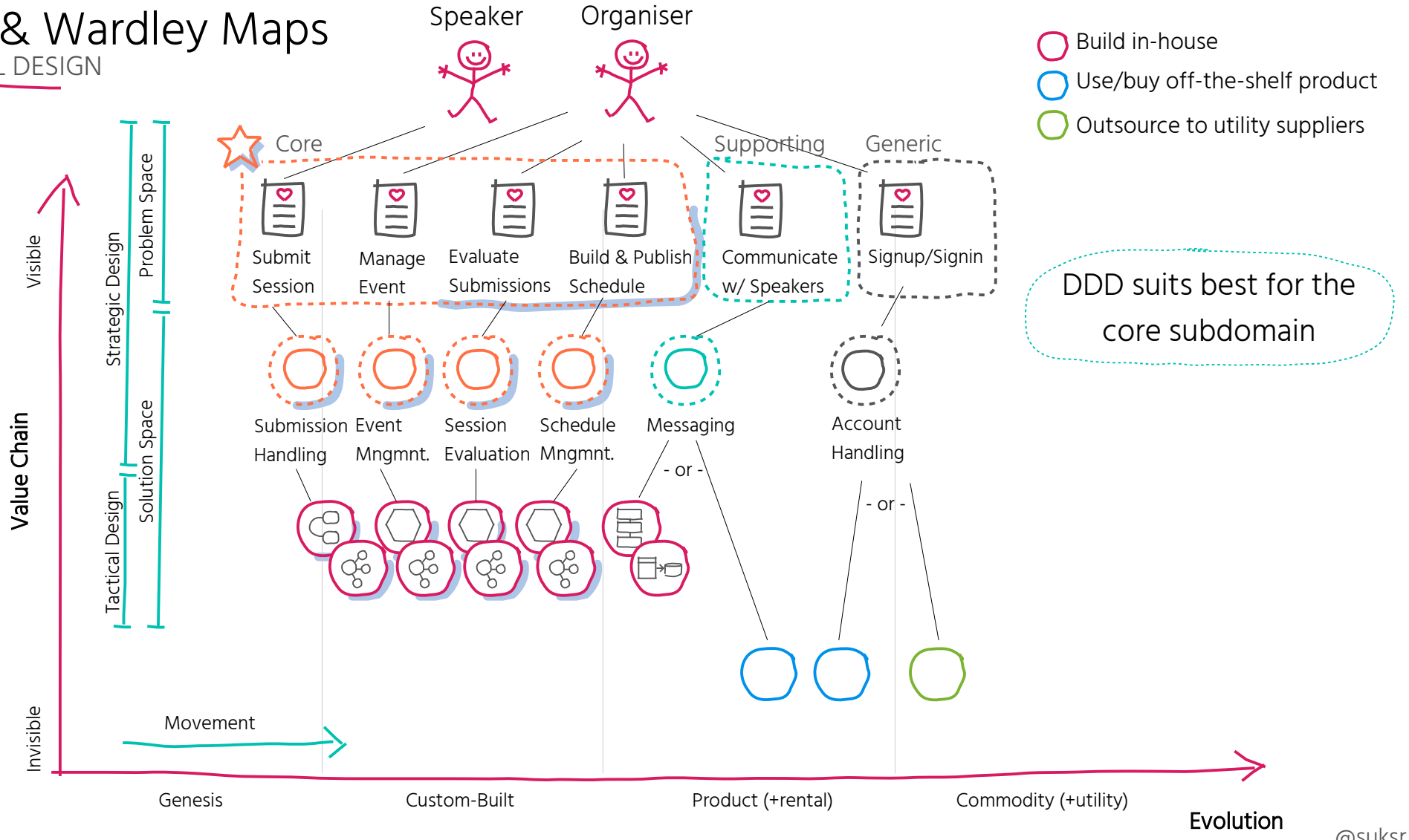
EVENT MANAGEMENT




```typescript
export default interface EventRepository {

    saveEvent(event: Event): void;
    eventOfId(id: EventId): Promise<Event|null>;
    // ... //
}
```

DDD & Wardley Maps

TACTICAL DESIGN



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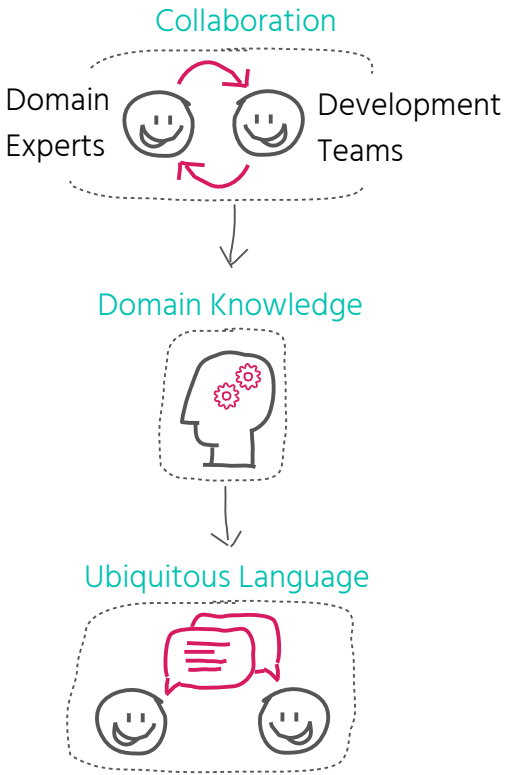
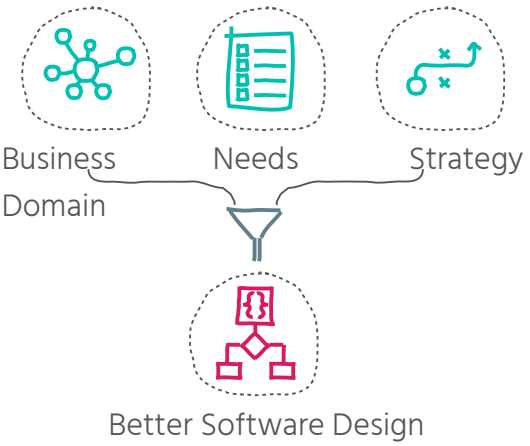
DDD helps with …



Gaining Domain Knowledge

Discovering the Core Subdomain

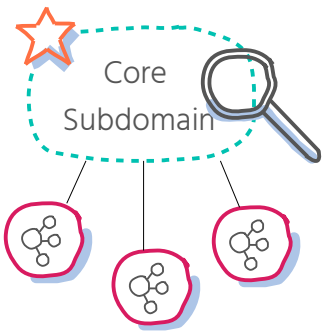


Aligning Software Design to Business Domain

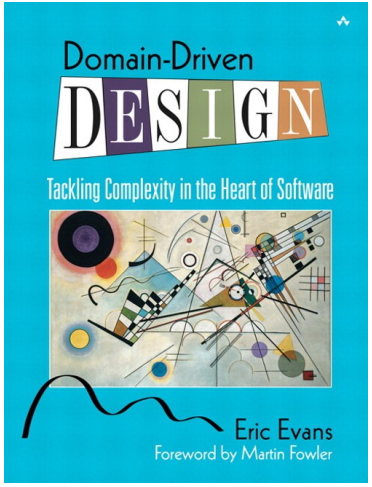
But …

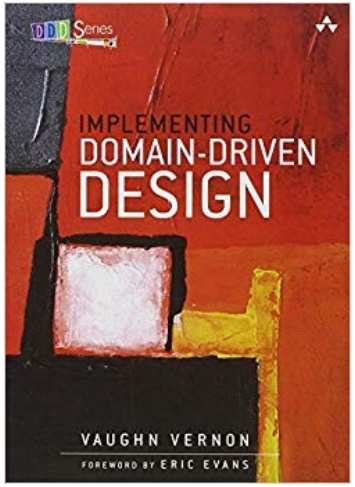
Do not apply DDD everywhere!

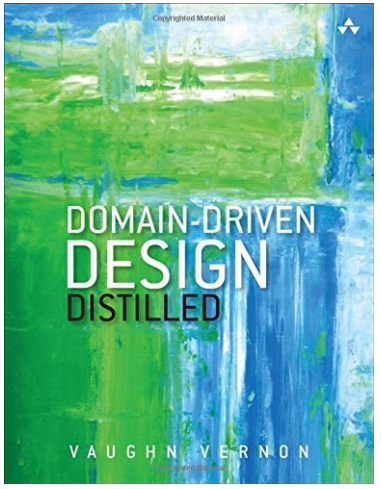
Focus on your core!

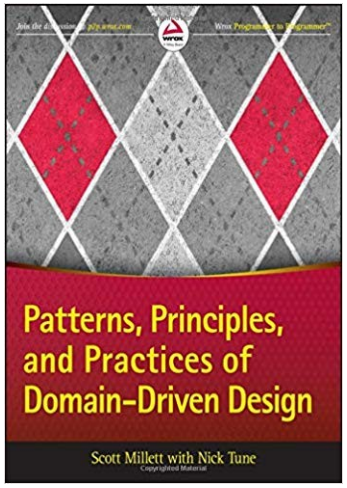


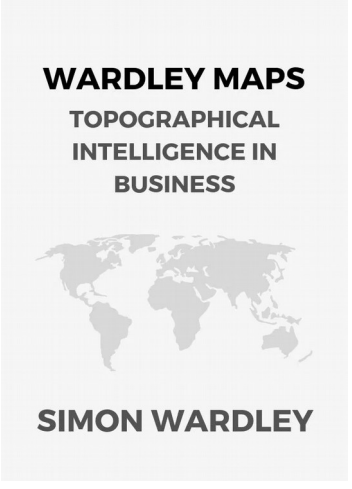
Some References











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