需求工程：核心概念
Requirements Engineering: Core Concepts

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- **Stages/Phase of SDLC**
  - Planning/Ideation
  - Requirements
  - Design
  - Implementation
  - Testing
  - Deployment
  - Maintenance

CONTENTS

需求工程是什么与为何重要

What is and why requirements engineering is important

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需求工程的定义 (Definition of requirements engineering)

需求工程是定义、文档化和维护需求的系统过程。它确保软件开发有明确的方向和目标，避免项目偏离预期。

Requirements engineering is the systematic **process of defining, documenting, and maintaining** requirements. It ensures that software development has a clear direction and goals, avoiding projects deviating from expectations.

02

类比说明 (Analogy illustration)

就像建造房屋需要蓝图一样，需求工程是软件开发的蓝图。没有它，软件开发就像在黑暗中摸索，容易出错。

Just like building a house requires a blueprint, requirements engineering is the blueprint for software development. Without it, software development is like fumbling in the dark and prone to errors.

03

重要性 (Importance)

需求工程的重要性在于它为后续的设计、测试和验收提供了基础。前期的共识可以减少后期的返工和成本。

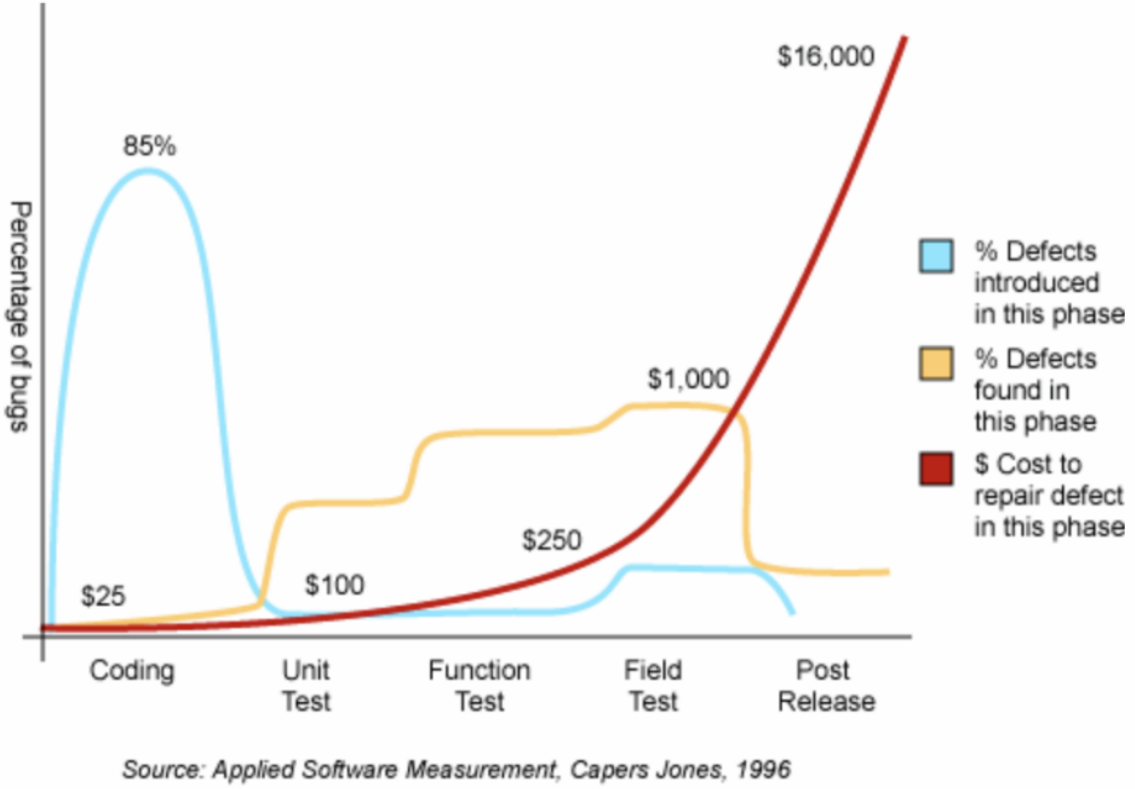
The importance of requirements engineering is that it provides the **basis for subsequent design, testing, and acceptance**. Consensus in the early stages can reduce rework and costs in the later stages.

缺陷发现得越晚，费用越高
The later the defect is discovered, the more costly it is costly it is

成本与时间的关系
The relationship between cost and time

在开发周期中，缺陷发现得越晚，修复成本越高。例如，运维阶段修复需求阶段的缺陷，成本可能放大百倍。

During the development cycle, the later defects are discovered, the higher the cost of fixing. For example, repairing defects in the requirements stage during the O&M phase can increase the cost by a hundredfold.



Source: Applied Software Measurement, Capers Jones, 1996

缺陷不断上升的成本：一个具体案例
The Rising Cost of Defects: A Concrete Example

场景：“用户密码重置”功能
Scenario: The "User Password Reset" Feature

Defect in Requirements Phase (需求阶段的缺陷)

The Flaw / 缺陷描述:
The requirement states: "The system shall email a new temporary password to the user."
需求说明为：“系统应通过电子邮件向用户发送一个新的临时密码。”

What's Missing? / 遗漏了什么？

It fails to specify that the temporary password must be invalid after 15 minutes and forced to change on first use.
它未能明确说明临时密码必须在15分钟后失效，并且用户首次登录时必须强制更改。

Cost to Fix / 修复成本:
A security expert raises this in a review.
一位安全专家在评审会议上指出了这一点。

Action 措施	Cost 成本
Update a few sentences in the requirements document. 修改需求文档中的几句话。	≈ 0.5 person-hours ≈ 0.5 人时

Defect in Coding Phase (编码阶段的缺陷)

The Flaw / 缺陷描述:
The developer implements the feature as specified, creating a permanent temporary password.
开发人员按照规格实现了该功能，创建了一个永久有效的临时密码。

Cost to Fix / 修复成本:
A code reviewer spots the logic error.
代码审查员发现了这个逻辑错误。

Action(s) 措施	Cost 成本
Add a new database field. (添加新的数据库字段。) Modify logic to check password age.(修改逻辑以检查密码时效。) Write code to invalidate expired passwords. 编写代码使过期密码失效。 Update unit tests. (更新单元测试。)	≈ 8 person-hours (a 16x increase) ≈ 8 人时 (成本增加 16 倍)

Defect in Testing Phase (测试阶段的缺陷)

The Flaw / 缺陷描述:

During security testing, a tester finds that temporary passwords never expire, creating a major vulnerability.
在安全测试期间，测试人员发现临时密码永不过期，这造成了一个严重的安全漏洞。

Cost to Fix / 修复成本:

Action(s) 措施	Cost 成本
All work from the coding phase fix. (包含编码阶段的所有修复工作。) Code must be reviewed again. (代码必须再次进行审查。) Intensive regression testing of the entire authentication module. 对整个认证模块进行深入的回归测试。 Test team updates test plan and cases. (测试团队更新测试计划和用例。) Potential release delay.(可能导致发布延迟。)	≈ 40 person-hours (an 80x increase) ≈ 40 人时 (成本增加 80 倍)

Defect in Production (Post-Release) 运营阶段（发布后）的缺陷

The Flaw / 缺陷描述:

A malicious actor exploits the non-expiring passwords to gain unauthorized access. A data breach occurs.

恶意攻击者利用永不过期的密码获取未授权访问。发生数据泄露。

Action(s) 措施

Emergency Fix & Deployment: "War room" assembly, high-priority patch.

紧急修复与部署： 组建“战时会议室”，开发最高优先级的补丁。

System Downtime: Service outage, losing revenue. 系统停机： 服务中断，导致收入损失。

Customer Notification: Legally mandated process. 用户通知： 法律要求的流程。

Cost to Fix (Catastrophic) / 修复成本（灾难性）:

Regulatory Fines: Potentially millions 监管罚款： 可能高达数百万美元

Legal Fees & Settlements: From class-action lawsuits.律师费与和解金： 来自集体诉讼。

Brand Damage & Customer Churn: Long-term financial impact.

品牌损害与客户流失： 长期财务影响。

Total Cost: Hundreds of thousands to millions of dollars (1000x+ increase)

总成本：数十万至数百万美元 (成本增加千倍以上)

缺陷发现越晚代价越高

The later the defect is discovered, the more costly it is

经济意义

Economic significance

前期精准的需求可以显著降低后期的返工成本，提高项目的经济效益和交付效率。

Precise requirements in the early stage can significantly reduce rework costs in the later stage, improving project economic efficiency and delivery efficiency.

需求的两种关键类型
Two Key Types of Requirements

功能需求定义系统行为
Functional requirements define system behavior

01

功能需求定义
Functional requirements definition

功能需求描述系统必须执行的具体行为，例如用户可以自助重置密码。这些需求是系统功能的基础。

Functional requirements describe the specific behaviors that the system must perform. These requirements are the basis for the functionality of the system.

02

可验证性 Verifiability

功能需求必须是可验证的，通常用‘系统应…’的句式书写，以便在测试阶段进行验证。

Functional requirements must be verifiable, usually written in the sentence 'The system should...' for validation during the testing phase.

03

Example 示例

例如，‘系统应允许用户重置密码’，这是一个典型的功能需求，明确了系统的一个具体功能。

For example, 'the system should allow users to reset their passwords', which is a typical functional requirement and clarifies a specific function of the system.

非功能需求约束系统质量
Non-functional requirements

01

非功能需求定义
Non-functional requirements definition

非功能需求规定系统执行功能时的质量属性，如性能、安全、可用性和可靠性。
Non-functional requirements specify the quality attributes of a system when performing its functions, such as performance, safety, availability, and reliability.

02

记录方式
Recording method

非功能性需求通常在补充规范中被记录，为系统设计提供全面的约束。
Non-functional requirements are typically documented in the Supplemental Specification, providing comprehensive constraints for the system design.

03

忽视后果
Ignore consequences

忽视非功能性需求可能导致系统架构重做，影响用户体验和系统稳定性。
Ignoring non-functional requirements can lead to system architecture rework, affecting user experience and system stability.

功能需求（示例）
Functional Requirements (example)

3. System Features

3.1 Manage Membership

* FR-1.1: The system shall allow a Librarian to register a new Member by capturing their full name, address, phone number, and email address.

* FR-1.2: The system shall automatically assign a unique Member ID and generate a physical library card number upon registration.

* FR-1.3: The system shall allow a Librarian to update a Member's details and deactivate their account.

* FR-1.4: The system shall prevent the registration of a duplicate Member (based on a combination of full name and email).

功能需求（示例）
Functional Requirements (example)

3.3 Process Loans

* FR-3.1: The system shall allow a Librarian to process a loan by scanning a Member ID and one or more Item barcodes.

* FR-3.2: The system shall only permit a loan if:

  * The Member's account is active and in good standing (fines below threshold).

  * The Member has not reached the maximum loan limit.

  * The Item is available (not already on loan, lost, etc.).

* FR-3.3: Upon successful loan, the system shall record the transaction, set the due date (e.g., 21 days from the loan date), and update the Item's status to "On Loan".

研讨会：定义拼车应用的 FRs/NFRs。

Workshop: Define FRs/NFRs for a ride-sharing app.

理解利益相关
Understanding the Stakeholders

干系人分析：谁关心这个系统？
Stakeholder Analysis: Who Cares?

A stakeholder is any **person or group with a vested interest** in the system.
干系人 是对系统拥有既得利益的任何个人或团体。

Goal / 目标:

To identify all relevant stakeholders and understand their influence, interests, and potential impact on the project's success.
识别所有相关的干系人，并理解他们的影响力、利益点以及对项目成功的潜在影响。

识别干系人
Identifying Stakeholders

- **Users / 用户:**
  End-users, managers, maintainers.
  最终用户、管理人员、维护人员。
- **Clients / 客户:**
  Those who pay for the system.
  为系统付费的人或组织。
- **Regulators / 监管机构:**
  Government bodies, standards organizations.
  政府机构、标准组织。
- **Developers / 开发人员:**
  The engineering team.
  工程团队（开发、测试等）。
- **Others / 其他:**
  Legal, marketing, support.
  法律、市场、支持团队。

记录干系人分析
Documenting Stakeholder Analysis

Stakeholder Register/Map / 干系人登记册/地图

A simple table to consolidate analysis. 一个用于汇总分析的简单表格。

Example Table / 示例表格:

Name 姓名	Role 角色	Influence 影响力 (High/Med/Low)	Interests / Key Concerns 利益/关键关注点	Communication Needs 沟通需求
Jane Doe	Project Sponsor	High	On-time delivery, budget	Weekly project status report
	项目发起人	高	按时交付、预算	每周项目状态报告
John Smith	End-User	Low	Ease of use, efficiency	Monthly newsletter, training sessions
	最终用户	低	易用性、效率	月度通讯、培训课程
Dr. Li	Regulatory Auditor	High	Legal compliance, data security	Formal review meetings, audit trails
	监管审计员	高	合法合规、数据安全	

了解网约车应用的利益相关
Understanding the Stakeholders for a Ride-Sharing App

- **Step 1:** Identify the Stakeholders

- **How to Perform:** Brainstorming and using a Stakeholder Map. We can categorize stakeholders to ensure no one is missed.

- The project lead (or architect) would call a kick-off meeting with key business representatives. The goal is to brainstorm and create a comprehensive list of all individuals, groups, or organizations that will be affected by the new system.

网约车应用的利益相关者类别
Categories of stakeholders for a Ride-Sharing App

1. Primary Stakeholders (Direct Users & Partners)

These are the people without whom the business model cannot function. They interact with the app directly.

2. Secondary Stakeholders (Internal & Enabling)

These groups are involved in the app's creation, maintenance, regulation, and support. They don't use the app for its core purpose but enable its existence.

3. Indirect & Tertiary Stakeholders (External & Broader Impact)

These groups are affected by the app's operation but do not directly interact with it. Their influence is often felt through regulation and public opinion.

1. Primary Stakeholders (Direct Users & Partners)

Stakeholder	Key Needs & Goals	Potential Pain Points
Riders (Passengers)	- Convenient, reliable, and affordable transportation - Safety during the ride - Clear pricing and easy payment - Clean and comfortable vehicle - Easy-to-use app	- Long wait times - Surge pricing - Unprofessional or unsafe drivers - Difficulty finding pickup location - Payment issues
Drivers (Partners)	- Flexible earning opportunities - Fair compensation and clear fee structure - Safe working environment - Steady stream of ride requests - Easy-to-use driver app with good navigation	- Low pay for time spent - Unruly or unsafe passengers - App malfunctions during a ride - Lack of support for issues - Unclear reasons for deactivation

2. Secondary Stakeholders (Internal & Enabling)

Stakeholder	Key Needs & Goals	Potential Pain Points
Development & Product Team	- Clear requirements (FRs/NFRs) - Modern, scalable technology stack - Efficient development and deployment cycles - User feedback to inform iterations	- Vague or changing requirements - Technical debt - Pressure to launch without proper testing
Company Management / Executives	- Business growth and market share - Profitability and revenue - Brand reputation and competitive advantage - Investor satisfaction	- Failing to meet business targets - Regulatory hurdles - Negative PR from safety incidents

2. Secondary Stakeholders (Internal & Enabling) contd…

Stakeholder	Key Needs & Goals	Potential Pain Points
Customer Support Agents	- Efficient tools to resolve rider/driver issues - Clear policies for handling disputes, refunds, and safety reports - Manageable ticket volume	- Lack of information from the app/system - Abusive users - Inconsistent policies
Payment Processors (e.g., Wexin, Alipay, Stripe)	- Reliable, secure API integration - High transaction volume - Low fraud rates	- Integration bugs causing failed payments - Security breaches - Chargebacks
Mapping/Navigation Providers (e.g., Baidu, Google Maps)	- Accurate and efficient use of their API - Proper attribution and billing	- High API call costs due to inefficient use - Incorrect implementation leading to poor user experience

3. Indirect & Tertiary Stakeholders (External & Broader Impact)

Stakeholder	Key Needs & Goals	Potential Pain Points
Regulators & City Governments	- Public safety and compliance with laws - Alleviation of traffic congestion - Fair labor practices for drivers - Data privacy compliance (e.g., GDPR, CCPA)	- Unregulated operations - Increased traffic or pollution - Disputes over driver employment status
Competitors (e.g., Didi, Uber, Lyft, Taxis)	- Maintain their own market share and profitability - Compete on features, price, and reliability	- Unfair competitive practices - Market saturation driving down prices
Insurance Companies	- Clear liability models in case of accidents - Accurate data for risk assessment	- Ambiguity in insurance coverage during different ride phases - High claim rates

3. Indirect & Tertiary Stakeholders (External & Broader Impact) contd…

Stakeholder	Key Needs & Goals	Potential Pain Points
Local Communities & Residents	- Reduced drunk driving - Less need for personal car ownership - Minimal disruption (e.g., noise, congestion)	- Cars blocking bike lanes or bus stops during pickups/drop-offs - Increased traffic in residential areas
Investors	- Return on Investment (ROI) - Sustainable and scalable business model - Strong company leadership and strategy	- Poor financial performance - Legal or regulatory risks threatening the business

了解网约车应用的利益相关
Understanding the Stakeholders for a Ride-Sharing App

- **Step 2:** Stakeholder Engagement Sessions
- **Goal:** Understand Everyone's Concerns and Needs
- **How to Perform:** Engagement Sessions (Interviews, Workshops etc.)

- After identifying the stakeholders, the architect conducts focused sessions (interviews, workshops) with each group to dig into their specific concerns.

利益相关者参与会议：
Stakeholder Engagement Sessions:

❑ 一对一访谈：公司管理层 / 投资者 **One-on-One Interview: Company Management / Executives & Investors**

Goal: To align on high-level business objectives, growth targets, funding runway, and overall product vision and strategy.

❑ 主持研讨会：乘客与司机代表**Facilitated Workshop: Rider & Driver Representatives**

Goal: To gather direct, in-depth feedback on the core user experience, pain points, safety concerns, and desired features.

❑ 协作工作坊：产品与开发团队 **Collaborative Workshop: Product & Development Team**

Goal: To translate business requirements and user feedback into technical specifications, user stories, and a feasible development roadmap.

❑ 用户反馈环节：客户支持团队 **User Feedback Session: Customer Support Agents**

Goal: To understand common user issues, system limitations from a support perspective, and gather data on what features would reduce ticket volume and improve resolution time.

利益相关者参与会议：
Stakeholder Engagement Sessions:

- 技术对接会议：支付处理商与地图导航提供商 **Technical Integration Meeting: Payment Processors & Mapping/Navigation Providers**

Goal: To discuss API capabilities, integration requirements, performance benchmarks, and co-development opportunities for critical third-party services.

- 正式咨询会议：监管机构与政府部门 **Formal Consultation Session: Regulators & City Governments**

Goal: To ensure compliance with local regulations, discuss data sharing requirements, address public safety policies, and align on operational standards.

- 市场分析会议：保险公司**Market Analysis Session: Insurance Companies**

Goal: To define insurance models, clarify liability coverage during different ride phases, and establish data protocols for claim processing.

- 社区聆听会：当地社区与居民**Community Listening Forum: Local Communities & Residents**

Goal: To address community concerns such as traffic congestion, idling at pick-up points, and noise, and to communicate the app's positive community impact.

- 竞争分析简报：内部团队（关于竞争对手）**Competitive Analysis Briefing: Internal Team (regarding Competitors)**

Note: Engagement with competitors is not typical. Instead, this is an internal session to analyze competitor features, pricing, and market positioning to inform our own strategy.

一对一访谈：公司管理层 / 投资者
One-on-One Interview: Company Management / Executives & Investors

Format: One-on-One Interview (Best for C-level, confidential strategic concerns)

Attendees: Chief Product Officer (CPO), Project Manager, [e.g., CEO / CFO / Lead Investor Name]

Duration: 60 minutes

CPO's Opening: "Thank you for your time today. Our goal is to deeply understand your strategic vision for this platform. We want to ensure the product we build not only succeeds in the market but also becomes a foundational service for urban mobility. There are no right or wrong answers; we're here to capture your perspective and align on what 'winning' looks like."

Strategic & Business Questions:

Long-Term Vision & Market Position: "Looking 3-5 years ahead, beyond just being a ride-hailing service, what role should our platform play in the broader urban transportation ecosystem? (e.g., integrating public transit, micro-mobility like e-bikes, or becoming a super-app for daily services?)"

Defining Success: "What are the top two or three key performance indicators (KPIs) you will use to personally judge this product a success? Is it primarily market share in key cities, monthly active riders, achieving profitability per ride, or perhaps driver retention rates?"

Financial Framework: "What is the budget range envisioned for the initial product development and launch? Furthermore, what level of ongoing investment is anticipated for annual operations, marketing, and continuous feature development to stay competitive?"

Strategic Constraints & Imperatives: "Are there any non-negotiable constraints we must design for? For example, a mandatory launch date to capture a specific market season, a requirement to use a specific cloud provider or payment gateway, or a strategic directive to avoid certain geographic markets?"

Pain Points & Competitive Edge: "From your perspective, what is the most significant weakness or missed opportunity in our current (or a competitor's) platform that we must solve with this new product? (e.g., driver-rider matching inefficiency, lack of a compelling loyalty program, or poor brand perception on safety?)"

公司管理层 / 高管与投资者（主要关注点）
Company Management / Executives & Investors (Primary Concerns)

- Budget & ROI: "Our growth spending on rider discounts and driver incentives must transition to a self-sustaining, profitable unit economics within the next funding cycle."
- Metrics: "I need real-time dashboards on city-level ride volume, driver utilization rates, and customer acquisition cost to validate our strategy and allocate capital."
- Market Position: "The platform must be flawless and reliable at launch to build a reputation of trust, as one major safety incident or service outage could cripple the brand."
- Compliance: "The system must be designed from the ground up to adhere to local transport regulations, data privacy laws, and dynamic insurance requirements in every market we enter."

主持研讨会：乘客与司机代表
Facilitated Workshop: Rider & Driver Representatives

Format: Focus Group Workshop (Best for gathering diverse user experiences and identifying conflicts/alignments)
Attendees: 3-4 Riders, 3-4 Drivers, UX Researcher (as facilitator), Product Manager, a Note-taker
Duration: 90 minutes
Materials: Whiteboard, sticky notes (two colors: one for Riders, one for Drivers), markers.

Facilitator's Opening: "Thank you all for joining us today. You are the heart of this platform—the reason it exists. Our goal is to listen and learn from your real-world experiences to build a better app for everyone. There are no right or wrong answers. We want to hear both the good and the bad. Let's all agree to be open and respectful of each other's perspectives."

Activity 1: The "Pain Point" Brainstorm (15 mins)
Instruction: "Thinking about your experience from start to finish—booking a ride or getting a request, the pickup, the trip, and the payment—write down the single most frustrating thing on a sticky note. Riders, use the blue notes. Drivers, use the yellow notes. One pain point per note. Be specific."

Examples from Riders: "The map pin for pickup is always in the wrong place." "I never know why the price is surging." "Drivers cancel after accepting, and I have to wait all over again."

Examples from Drivers: "I arrive at the pin and the rider isn't there." "I lose money waiting in traffic on a long pickup for a short trip." "The app's navigation tries to take me down a closed road."

主持研讨会：乘客与司机代表
Facilitated Workshop: Rider & Driver Representatives

Activity 2: "A Journey" Walkthrough (30 mins)
Instruction: "Let's walk through two key scenarios. First, a rider's journey: trying to get home during a rainy Friday rush hour. Then, a driver's journey: starting their shift and getting their first few ride requests. Let's talk about each step, what you expect the app to do, and where it lets you down."

Probing for Riders: "The app says 5 minutes, but it's been 10. What are you thinking? How do you know your driver is coming?"

Probing for Drivers: "You get a request that's 12 minutes away. What information do you need to decide if you should accept? What's missing?"

主持研讨会：乘客与司机代表
Facilitated Workshop: Rider & Driver Representatives

Activity 3: "Magic Wand" Ideation (20 mins)
Instruction: "If you had a magic wand and could create the perfect ride-sharing experience, what would it look like? Don't worry about technology. What would it do for you?"

Probing Questions for Riders:
"How could the app make you feel 100% safe before and during the ride?"
"What if the app could learn your preferences? What would it learn?"

Probing Questions for Drivers:
"What would the perfect earnings summary show you at the end of a day?"
"Describe a feature that would make you feel more respected and supported by the platform."

主持研讨会：乘客与司机代表
Facilitated Workshop: Rider & Driver Representatives

Activity 4: Prioritization (10 mins)

Instruction: "We have all these pain points and ideas from both groups. Now, we'll put them all on the whiteboard. Each of you gets three 'dots'. Place your dots on the three issues or ideas that are most critical to fix or implement first. This tells us what matters most to our users."

骑手与驾驶代表（主要关注点）：
Rider & Driver Representatives (Primary Concerns):

- **Rider Core Concern:** "The entire process—from a reliable ETA and accurate pickup location to a smooth payment—needs to be predictable and transparent. I need to trust that the app will do what it says it will do."
- **Driver Core Concern:** "My time is my money. The system must minimize unpaid work like long pickups, wrong addresses, and navigation errors, while ensuring I am paid fairly and on time for every trip."
- **Mutual Core Concern (Safety & Respect):** "There is a fundamental need for safety and clear communication for both parties. Riders need to know who is driving them, and drivers need to know they are picking up a respectful passenger, with a direct way to report issues."
- **Mutual Core Concern (Fairness & Control):** "Both sides feel a lack of control. Riders feel powerless against surge pricing and cancellations. Drivers feel the matching and earning algorithms are a 'black box.' The system needs to feel more fair and give users agency."

协作工作坊：开发团队
Collaborative Workshop: Development Team

Format: Technical Planning Workshop
Attendees: Developers, QA Engineers, DevOps, Architect (as facilitator)
Duration: 60 minutes

Architect's Opening: "Team, we've gathered a lot of requirements from the business and users. Now, we need your expertise to pressure-test them and plan how we'll build this. Let's talk about risks, technology, and how we can set ourselves up for success."

Activity 1: "Requirements Clarification" (20 mins)
Instruction: "Here are the top 5 user stories we've heard. Let's read them one by one and ask the '5 Whys' to get to the root of what's needed. For example, 'The user needs to check out 5 books in under 60 seconds.' What does that really mean for the database, the UI, and the hardware?"

Activity 2: "Technology & Risk Storming" (30 mins)
Instruction: "Let's brainstorm on two whiteboards."
- ❑ Board 1 - Technology: "What technologies are we considering for the frontend, backend, and database? List pros and cons. Let's debate."
- ❑ Board 2 - Risks: "What are our biggest technical risks? (e.g., 'How will we handle peak load during summer reading program?')."

Activity 3: "Definition of Done" (10 mins)
Instruction: "For a feature like 'Member can place a hold,' what does 'Done' mean? Is it just coded? Does it need unit tests, integration tests, UX review, and documentation? Let's agree on our standard."

开发团队主要关注点
Development Team Primary Concerns

- **Clarity = No Ambiguity**
  - Bad: "Fast", "Easy", "User-friendly"
  - Good: "Under 2 seconds", "3 clicks maximum", "95% user satisfaction"
- **Feasibility = Reality Check**
  - Ask: "Can we actually build this with our time, budget, and skills?"
  - Always have a Plan B for infeasible requests
- **Technology = Future-Proofing**
  - Choose technologies that won't be obsolete next year
  - Balance innovation with stability
  - Consider team skills and learning curve
- **Change Management = Project Protection**
  - Remember: It's easier to say "no" to a documented request than to an informal ask
  - Without process: Chaos, missed deadlines, blown budgets
  - With process: Controlled evolution, predictable outcomes

Summary Output of Phase 1, Step 1 and 2 Document: Stakeholder Analysis Register

Stakeholder	Role	Key Concerns & Needs	Influence (H/M/L)	Engagement Strategy
Riders (Passengers)	End-User (Customer)	**Reliability & Predictability:** Accurate ETAs, clear pricing, no last-minute cancellations. **Safety:** Knowing driver details, sharing trip status, in-app emergency features. **Cost:** Affordable, transparent fares without hidden surges. **Ease of Use:** Seamless booking, payment.	High	**Focus Group Workshops & Feedback Sessions:** To gather direct input on UX, pain points, and desired features. Continuous feedback via in-app surveys.
Drivers (Partners)	End-User (Service Provider)	**Earnings & Fairness:** Maximizing paid time, clear breakdown of fares and fees, timely payouts. **Efficiency:** Optimal ride matching, minimal unpaid pickup time, reliable navigation. **Safety & Respect:** Passenger vetting, in-app support for issues.	High	**Focus Group Workshops & Dedicated Forums:** To understand operational challenges and co-create solutions. A dedicated driver liaison for ongoing communication.

Summary Output of Phase 1, Step 1 and 2 Document: Stakeholder Analysis Register

Stakeholder	Role	Key Concerns & Needs	Influence (H/M/L)	Engagement Strategy
Company Management / Investors	Decision Maker / Funder	**ROI & Growth:** Path to profitability, market share dominance. **Brand Reputation:** Maintaining a safe, reliable brand to ensure user trust. **Compliance:** Operating within legal frameworks to avoid costly penalties.	High	One-on-One Interviews & Strategy Briefings: Regular, high-level meetings to align on vision.
Product & Development Team	Builder / Implementer	**Clear Requirements:** Well-defined FRs/NFRs to build against. **Technical Feasibility:** Realistic timelines and the right technology stack. **User Feedback:** Direct input from users to inform iterations and prioritization.	High	Collaborative Workshops: Daily stand-ups, sprint planning, and refinement sessions to ensure clarity and feasibility.

利益相关者综合关注点
Consolidated Stakeholder Concerns

From Management/Investors:

- ❑"Must demonstrate path to profitability within 18 months, with clear unit economics per ride."
- ❑"Need to capture 25% market share in Tier 1 cities within first year of operation."
- ❑"Platform must be 99.9% reliable during peak hours to build brand trust."

From Riders:

- ❑"Pickup ETA must be accurate within ±2 minutes. Cancellation after driver assignment should incur automatic penalty."
- ❑"Surge pricing must be clearly explained with breakdown before ride confirmation."
- ❑"In-app safety features must include real-time ride sharing and emergency button accessible in one tap."

利益相关者综合关注点
Consolidated Stakeholder Concerns

From Drivers:

- ❑ "Matching algorithm must prioritize minimizing unpaid pickup time (under 8 minutes average)."
- ❑ "Earnings calculation must be transparent with clear breakdown of fares, commissions, and incentives."
- ❑ "Navigation must avoid traffic jams and road closures with real-time rerouting."

From Product/Development Team:

- ❑ "Performance requirements must be quantifiable: app cold start under 3 seconds, map loading under 2 seconds."
- ❑ "Payment processing must maintain 99.95% uptime with fallback mechanisms for poor connectivity."
- ❑ "Need clear API documentation from mapping/payment partners before integration phase."

From Customer Support:

- ❑ "Admin dashboard must show complete ride history and enable instant refund processing within 2 clicks."
- ❑ "Must have direct in-app communication channel between support and active riders/drivers."
- ❑ "Fraud detection system must flag suspicious ride patterns in real-time."

利益相关者综合关注点
Consolidated Stakeholder Concerns

- **From Regulators:**

❑"Must provide automated data feeds for ride tracking and driver compliance to city transportation department."

❑"Background check integration with official databases required before driver activation."

❑"Data privacy must comply with GDPR/CCPA - user data deletion within 72 hours upon request."

- **From Payment Providers:**

❑"Transaction processing must handle 1,000 TPS during peak hours with 256-bit encryption."

❑"Must implement 3D Secure 2.0 for all card payments in regulated markets."

❑"Chargeback rate must remain below 0.5% to maintain preferred partner status."

利益相关者综合关注点
Consolidated Stakeholder Concerns

From Insurance Partners:

- ❑"System must clearly distinguish insurance coverage periods: waiting for ride request vs. enroute to pickup vs. trip in progress."
- ❑"Real-time trip data (route, duration, passengers) must be available for claim processing within 24 hours."

From Local Communities:

- ❑"Geofencing must prevent idling in residential zones between 10 PM - 6 AM."
- ❑"Pickup/drop-off points must avoid blocking bus stops and bike lanes."

These concrete, measurable concerns from all stakeholder groups will now be formalized into specific Functional and Non-Functional Requirements in the next phase of system design.

A. 功能需求（系统将执行什么）
A. Functional Requirements (What the system will DO)

- These are derived from the desired features.

ID	Requirement Description	Source (Stakeholder Concern)
FR1	The system shall allow riders to input pickup and destination locations and see an estimated fare and ETA before confirming the ride.	Rider Convenience, Transparency
FR2	The system shall display real-time driver location and updated ETA on a map interface from assignment until pickup completion.	Rider Reliability, Driver Efficiency
FR3	An authenticated rider shall be able to select from multiple ride types (Standard, Pool, Premium) with clear pricing differences.	Rider Choice, Business Model
FR4	The system shall allow drivers to go online/offline and automatically match them with the nearest ride request based on proximity and ride type compatibility.	Driver Autonomy, Operational Efficiency

ID	Requirement Description	Source (Stakeholder Concern)
FR5	The system shall automatically calculate final fares based on distance, time, base fare, and dynamic pricing factors, with detailed breakdown shown to both parties.	Pricing Transparency, Business Logic
FR6	The system shall provide dedicated interfaces for riders and drivers to rate each other on a 1-5 star scale after ride completion.	Quality Control, Community Trust
FR7	The system shall send automated push notifications for: a) Ride assignment to drivers, b) Driver arrival to riders, c) Ride completion and receipt.	User Convenience, Operational Efficiency
FR8	The system shall enforce Role-Based Access Control (RBAC): • RIDER: Can access FR1, FR2, FR3, FR5, FR6, FR7 and their own trip history • DRIVER: Can access FR4, FR5, FR6, FR7 and their earnings dashboard • SUPPORT: Can access all rider/driver data and process refunds • ADMIN: All access, including platform analytics and configuration	Security, Business Rules

ID	Requirement Description	Source (Stakeholder Concern)
FR9	The system shall allow support agents to view complete ride history, process instant refunds, and temporarily suspend user accounts for safety violations.	Support Efficiency, Safety Compliance
FR10	The system shall integrate with third-party navigation services to provide drivers with turn-by-turn directions to pickup and destination locations.	Driver Efficiency, Operational Reliability
FR11	The system shall process payments automatically at ride completion using the rider's default payment method and transfer earnings to the driver's account weekly.	Payment Processing, Driver Earnings
FR12	The system shall provide safety features including: a) Ride sharing with emergency contacts, b) In-app emergency button, c) Anonymized contact between rider/driver.	Rider Safety, Driver Safety, Regulatory Compliance

B. 非功能性需求（系统能否完成这些任务）
B. Non-Functional Requirements (How well the system will DO it)

ID	Requirement Description	Metric & Source
NFR-P1	Ride Matching Response Time: The system shall match riders with available drivers within 10 seconds for 95% of ride requests under normal load of 50,000 concurrent users.	Metric: ≤ 10 sec response time for 95th percentile. Source: Rider Convenience, Operational Efficiency.
NFR-P2	Ride Booking Transaction Time: A rider shall be able to complete a ride booking (from app open to driver assignment) in under 30 seconds on a standard 4G connection.	Metric: ≤ 30 sec end-to-end transaction time. Source: Rider Convenience (Workshop feedback).
NFR-P3	Concurrent Users: The system shall support up to 200,000 concurrent active users during peak hours (e.g., Friday evenings, New Year's Eve) without significant performance degradation.	Metric: 200,000 concurrent users. Source: Business Growth Projections, Market Share Goals.
NFR-P4	Real-time Location Updates: Driver location on the rider's map shall update at least every 5 seconds with position accuracy within 15 meters.	Metric: 5-second refresh rate, ±15m accuracy. Source: Rider Experience, Driver Navigation.

B.2. 可用性与可靠性
B.2. Availability & Reliability

ID	Requirement Description	Metric & Source
NFR-A1	System Uptime: The core ride-matching and payment processing systems shall be available 99.95% during peak operating hours (6:00 AM - 2:00 AM local time, 7 days a week).	Metric: 99.95% uptime = ~4.5 hours downtime/year. Source: Business Continuity, Rider Reliability.
NFR-A2	Payment Reliability: The payment processing system must successfully complete 99.9% of transactions on first attempt, with automatic retry mechanisms for failed transactions.	Metric: 99.9% first-attempt success rate. Source: Driver Earnings, Rider Trust.
NFR-A3	Data Consistency: The system must prevent double-booking of the same driver for multiple rides. Driver availability status must be accurate at the time of ride assignment.	Metric: 0% occurrence of double-booking in production. Source: Operational Accuracy, Driver Experience.

B.3. 安全性
B.3. Security

ID	Requirement Description	Metric & Source
NFR-S1	Data Encryption: All sensitive user data (payment info, location history, personal details) shall be encrypted in transit (TLS 1.2+) and at rest (AES-256).	Metric: Security audit confirms encryption standards; penetration testing passes. Source: Privacy Laws (GDPR/CCPA), User Trust.
NFR-S2	Authentication & Authorization: The system shall enforce RBAC as defined in FR8. Multi-factor authentication shall be required for driver accounts and admin access.	Metric: Penetration testing confirms access violations are impossible. Source: IT Security, Regulatory Compliance.
NFR-S3	Audit Logging: The system shall maintain immutable logs of all security-sensitive actions (logins, payment changes, ride cancellations, support actions) retained for 7 years.	Metric: Logs exist and are searchable for all key events; automated alerting for suspicious patterns. Source: Regulatory Compliance, Fraud Prevention.

B.4. 可用性
B.4. Usability

ID	Requirement Description	Metric & Source
NFR-U1	Mobile App Performance: The rider and driver apps shall achieve cold start time under 3 seconds and maintain consistent 60fps animation on supported mobile devices.	Metric: ≤ 3 sec cold start; 60fps rendering. Source: User Experience, Competitive Benchmarking.
NFR-U2	Accessibility: The mobile applications shall meet WCAG 2.1 Level AA guidelines to ensure accessibility for users with disabilities.	Metric: Audit report from accessibility testing tools (e.g., axe). Source: Inclusivity, Regulatory Compliance.
NFR-U3	Offline Functionality: The rider app shall allow users to view recent trips and receipts while offline. The driver app shall cache navigation data for poor connectivity areas.	Metric: Core offline features functional with < 2-minute sync when back online. Source: User Convenience, Operational Reliability.

B.5. 可整合性与运算
B.5. Integrability & Operations

ID	Requirement Description	Metric & Source
NFR-I1	Payment Gateway Integration: The system shall integrate with multiple payment processors (Stripe, PayPal, etc.) with automatic failover if one provider is unavailable.	Metric: 99.9% payment success rate across all integrated providers. Source: Business Continuity, Global Expansion.
NFR-I2	Mapping Service Integration: The system shall support integration with multiple mapping providers (Google Maps, Mapbox) with the ability to switch providers with minimal downtime.	Metric: < 4 hours provider switchover time. Source: Operational Flexibility, Cost Management.
NFR-O1	Backup & Recovery: The system must support automated daily backups with ability to restore to any point within last 72 hours. Recovery Time Objective (RTO) < 2 hours.	Metric: Documented and tested RTO < 2 hours, RPO < 15 minutes. Source: Business Continuity, Investor Confidence.
NFR-O2	Monitoring & Alerting: The system shall provide real-time monitoring of all critical services with automated alerts for performance degradation or service failures.	Metric: < 1 minute alert time for critical failures; 24/7 monitoring coverage. Source: Operational Excellence, Investor Requirements.

C. 业务与技术限制
C. Business & Technical Constraints

- These are non-negotiable decisions that frame the project.

ID	Constraint Description	Type	Source
C1	The platform must achieve positive unit economics (profit per ride) within 18 months of initial launch.	Business	Investors (ROI Requirement)
C2	The mobile apps must launch in Tier 1 cities by Q4 2026 to secure Series B funding.	Business	Investors (Funding Timeline)
C3	The backend services must be developed using Node.js/Python to align with current engineering team expertise and accelerate development.	Technical	CTO (Team Capability)
C4	The entire system must be deployable on AWS using containerized architecture (Docker/Kubernetes) for scalability and operational consistency.	Technical	DevOps Team (Infrastructure Standard)
C5	The mobile applications must support iOS 15+ and Android 10+ to cover 95% of target market devices while limiting testing complexity.	Technical	Product & Development Teams

C. 业务与技术限制
C. Business & Technical Constraints

ID	Constraint Description	Type	Source
C6	All user data must be stored in encrypted format within US-based data centers to comply with data sovereignty requirements.	Technical	Legal & Compliance Team
C7	The system must integrate with Stripe as the primary payment processor for initial launch, with PayPal integration deferred to Phase 2.	Business	Product Strategy (Time-to-Market)
C8	The driver onboarding process must include mandatory background checks using Checkr API integration before account activation.	Business	Legal & Safety Requirements
C9	The rider app must support English and Spanish at launch, with additional languages planned for future releases.	Business	Market Strategy (Initial Focus)
C10	The platform must maintain 99.9% uptime during peak hours (6 PM - 2 AM) as per service level agreements with enterprise customers.	Business	Enterprise Contracts

优先排序：**MoSCoW，Kano模式。**

Prioritization: MoSCoW, Kano Model.

MoSCoW 方法 - 解释与应用
MoSCoW Method - Explanation & Application

MoSCoW is a prioritization framework that categorizes requirements into four buckets:

- ❑MUST HAVE: Critical requirements without which the system fails
- ❑SHOULD HAVE: Important but not vital requirements
- ❑COULD HAVE: Desirable but not necessary requirements
- ❑WON'T HAVE: Explicitly excluded from current scope

必有（MVP - 最小可行产品）：
MUST HAVE (MVP - Minimum Viable Product):

- ❑FR1: Ride booking with estimated fare/ETA
- ❑FR4: Driver matching and online/offline status
- ❑FR5: Fare calculation and payment processing
- ❑FR11: Basic payment processing
- ❑NFR-P1: Ride matching < 10 seconds
- ❑NFR-A1: 99.9% uptime during peak hours
- ❑NFR-S1: Data encryption
- ❑C1: Positive unit economics in 18 months

应该有（MVP后2-3个月发布）：
SHOULD HAVE (Release 2-3 months post-MVP):

- ❑FR2: Real-time driver tracking
- ❑FR3: Multiple ride types
- ❑FR6: Rating system
- ❑FR7: Push notifications
- ❑FR12: Basic safety features (ride sharing)
- ❑NFR-U1: App performance (3-second cold start)

可能（未来发行作品）：
COULD HAVE (Future releases):

- ❑FR9: Advanced support features
- ❑FR13: Geofencing restrictions
- ❑NFR-U2: Full WCAG accessibility
- ❑NFR-U3: Offline functionality
- ❑NFR-I2: Multiple mapping providers

不会（明确排除在当前范围之外）：
WON'T HAVE (Explicitly excluded from current scope):

- ❑International expansion features
- ❑Advanced carpooling algorithms
- ❑Integration with micromobility (bikes/scooters)
- ❑Enterprise fleet management features

Kano模型—解释与应用
Kano Model - Explanation & Application

The Kano Model classifies features based on customer satisfaction:

- ❑BASIC: Expected features (cause dissatisfaction if missing)
- ❑PERFORMANCE: Linear satisfaction (more is better)
- ❑EXCITEMENT: Delighters (unexpected but create loyalty)
- ❑INDIFFERENT: Features users don't care about

基本期望（必须出席）：
BASIC EXPECTATIONS (Must be present):

- ❑Reliable ride matching (FR1, FR4)
- ❑Accurate fare calculation (FR5)
- ❑Secure payment processing (FR11, NFR-S1)
- ❑Basic safety (driver identification)
- ❑Functional mobile app (NFR-U1)

性能特点（更多=更好）：
PERFORMANCE FEATURES (More = Better):

- ❑Faster matching times (NFR-P1)
- ❑Lower prices/competitive fares
- ❑More drivers available (NFR-P3)
- ❑Shorter wait times
- ❑Better navigation accuracy (FR10)

兴奋/喜悦者（竞争优势）：
EXCITEMENT/DELIGHTERS (Competitive Advantage):

- ❑Advanced safety features (FR12 - emergency button, ride sharing)
- ❑Predictive ETAs using AI
- ❑Loyalty programs and rewards
- ❑Seamless multi-modal transportation
- ❑Personalized ride preferences
- ❑Real-time customer support (FR9)

无关紧要的功能（低优先级）：
INDIFFERENT FEATURES (Low priority):

- ❑Complex social features
- ❑Overly detailed driver bios
- ❑Multiple language support beyond core markets
- ❑Advanced analytics for casual users

优先级排序确保了：
The prioritization ensures:

- Business Viability: Meets investor ROI constraints
- User Adoption: Delivers core value immediately
- Scalable Foundation: Builds platform for future features
- Competitive Positioning: Balances essential features with differentiators
- The combination of both models provides both business-focused (MoSCoW) and customer-centric (Kano) perspectives for balanced decision-making.