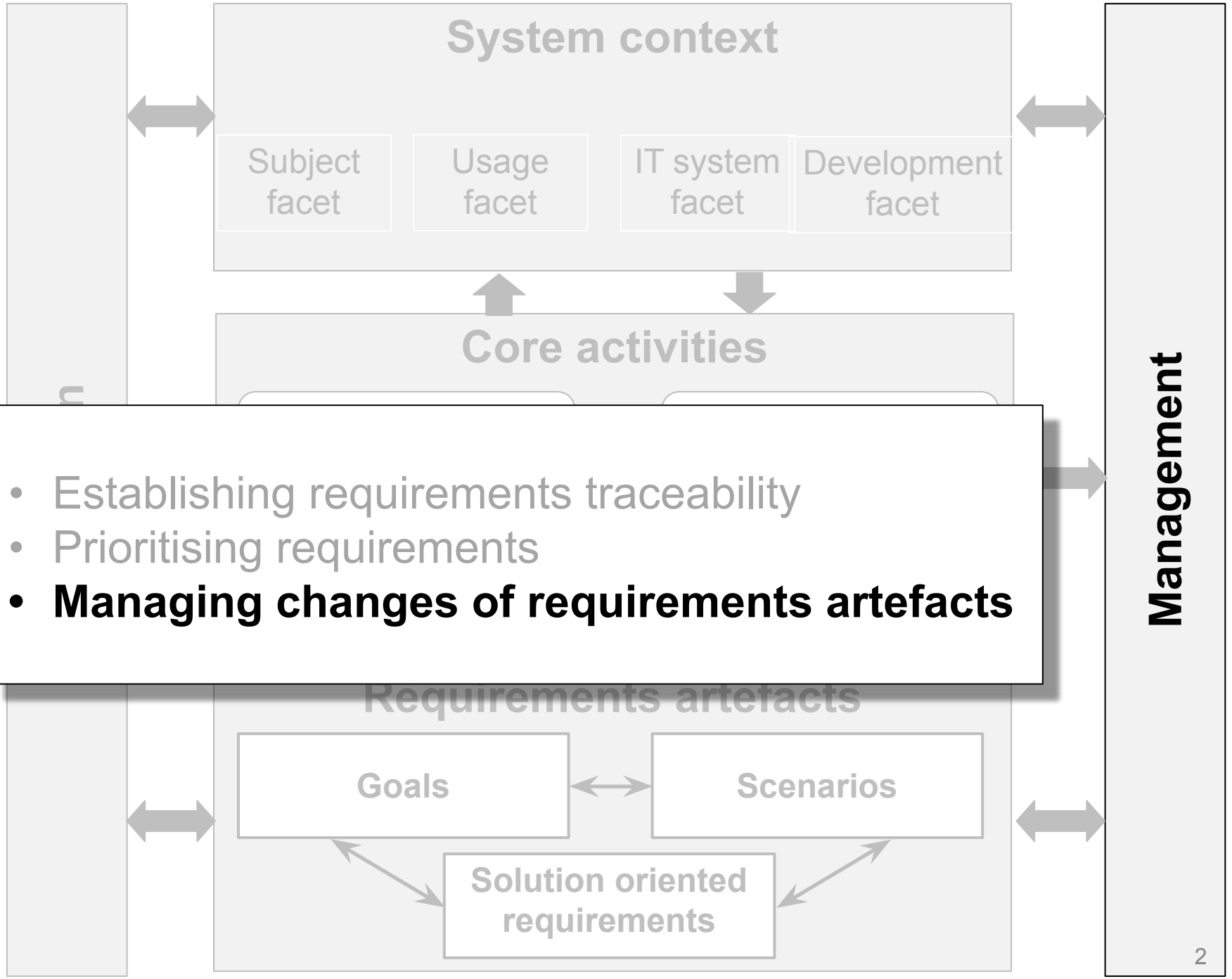
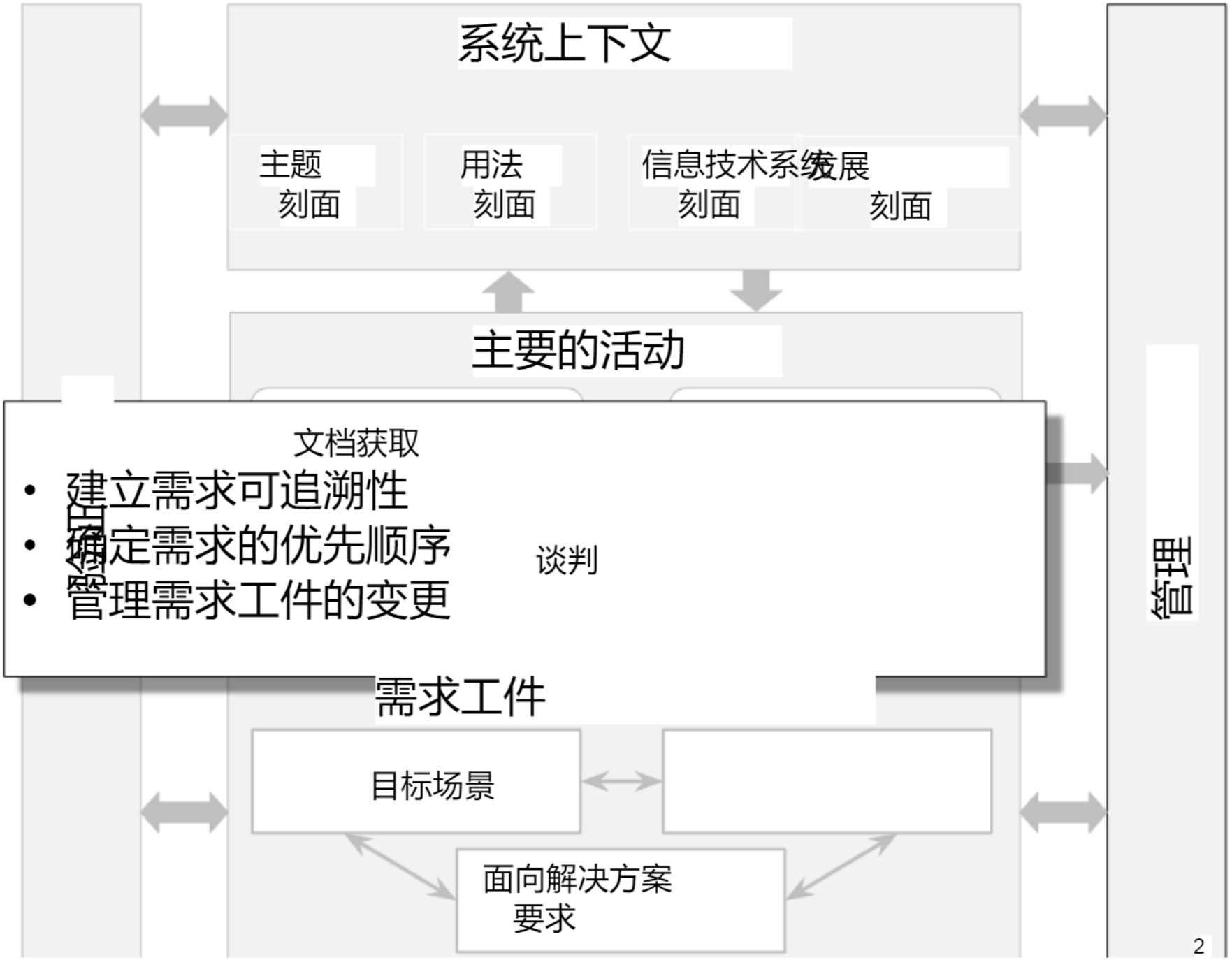
MTAT.03.306

Requirements Change Management

MTAT.03.306

需求变更管理


System context
Subject facet
Usage facet
IT system facet
Development facet
Core activities
Requirements artefacts
Goals
Scenarios
Solution oriented requirements
Management
• Establishing requirements traceability
• Prioritising requirements
• Managing changes of requirements artefacts


系统上下文
主题
刻面
用法
刻面
信息技术系统
刻面
发展
刻面
主要的活动
文档获取
建立需求可追溯性
确定需求的优先顺序
管理需求工件的变更
谈判
管理
需求工件
目标场景
面向解决方案
要求

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- Configuration management
- Requirements changes
- Causes for requirements change
- Activities of change management

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- 配置管理
- 需求变更
- 需求变更的原因
- 变革管理活动

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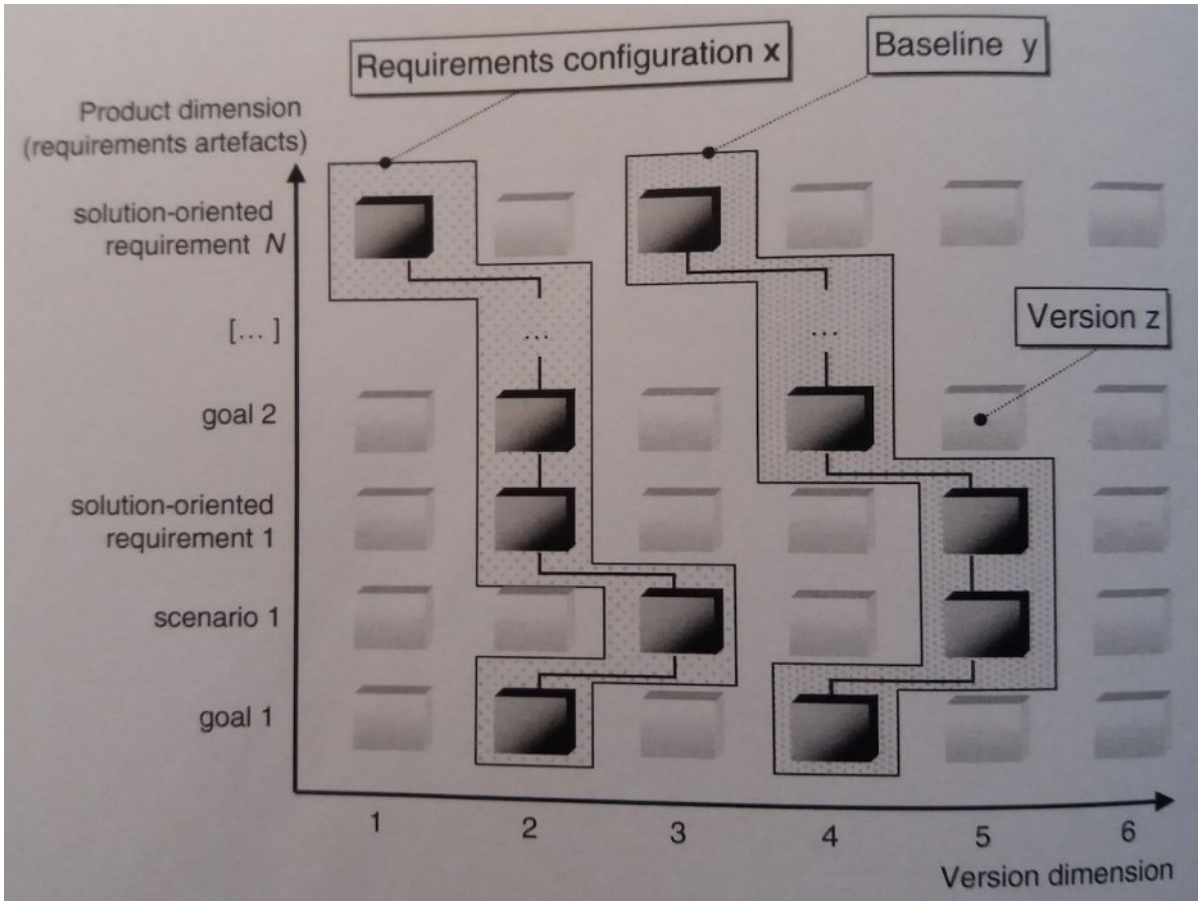
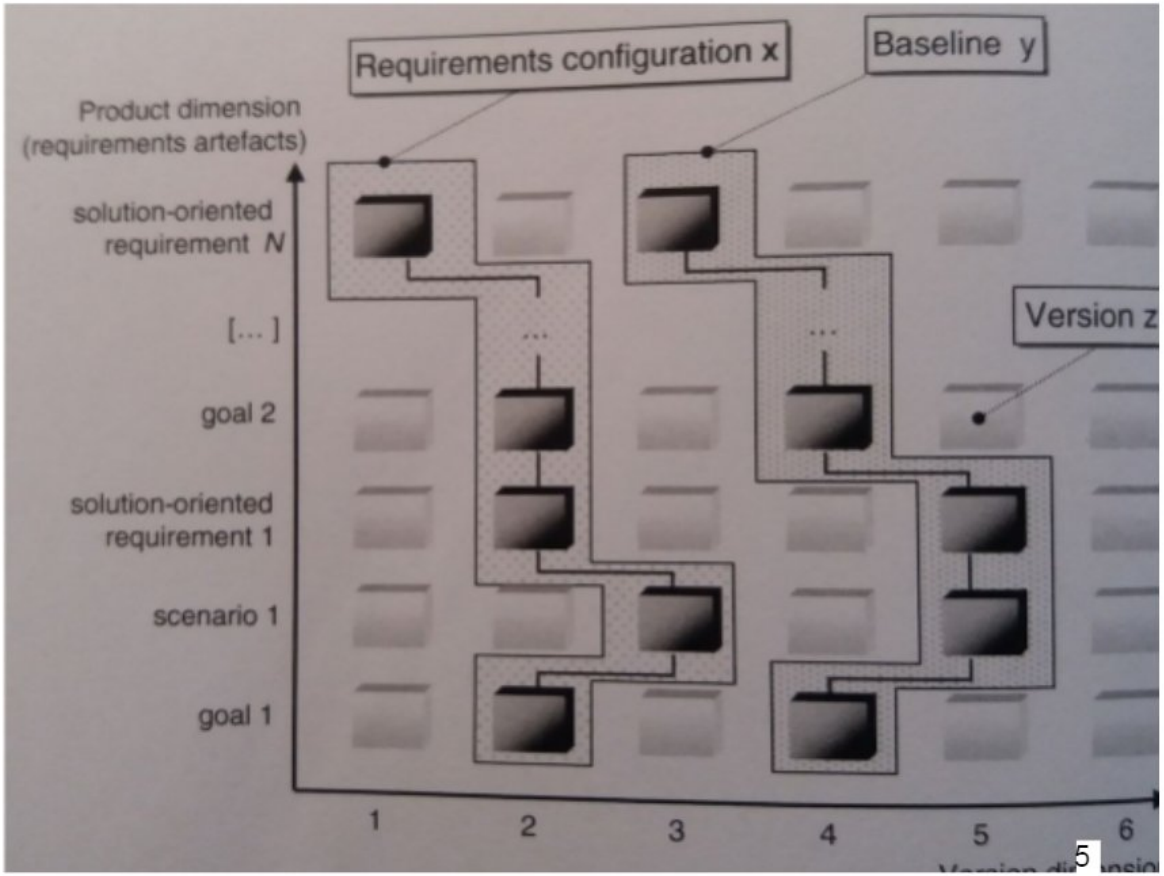
Configuration Management

- **Product (artefact) dimension**
  - Concrete goals, scenarios, and solution-oriented requirements
- **Version dimension**
  - Manages different change states of the artefact of the product dimension



配置管理

- 产品（制品）尺寸
  - 具体目标、场景和面向解决方案的要求
- 版本尺寸
  - 管理不同
    改变状态
    的人工制品
    产品尺寸



Configuration Management Levels

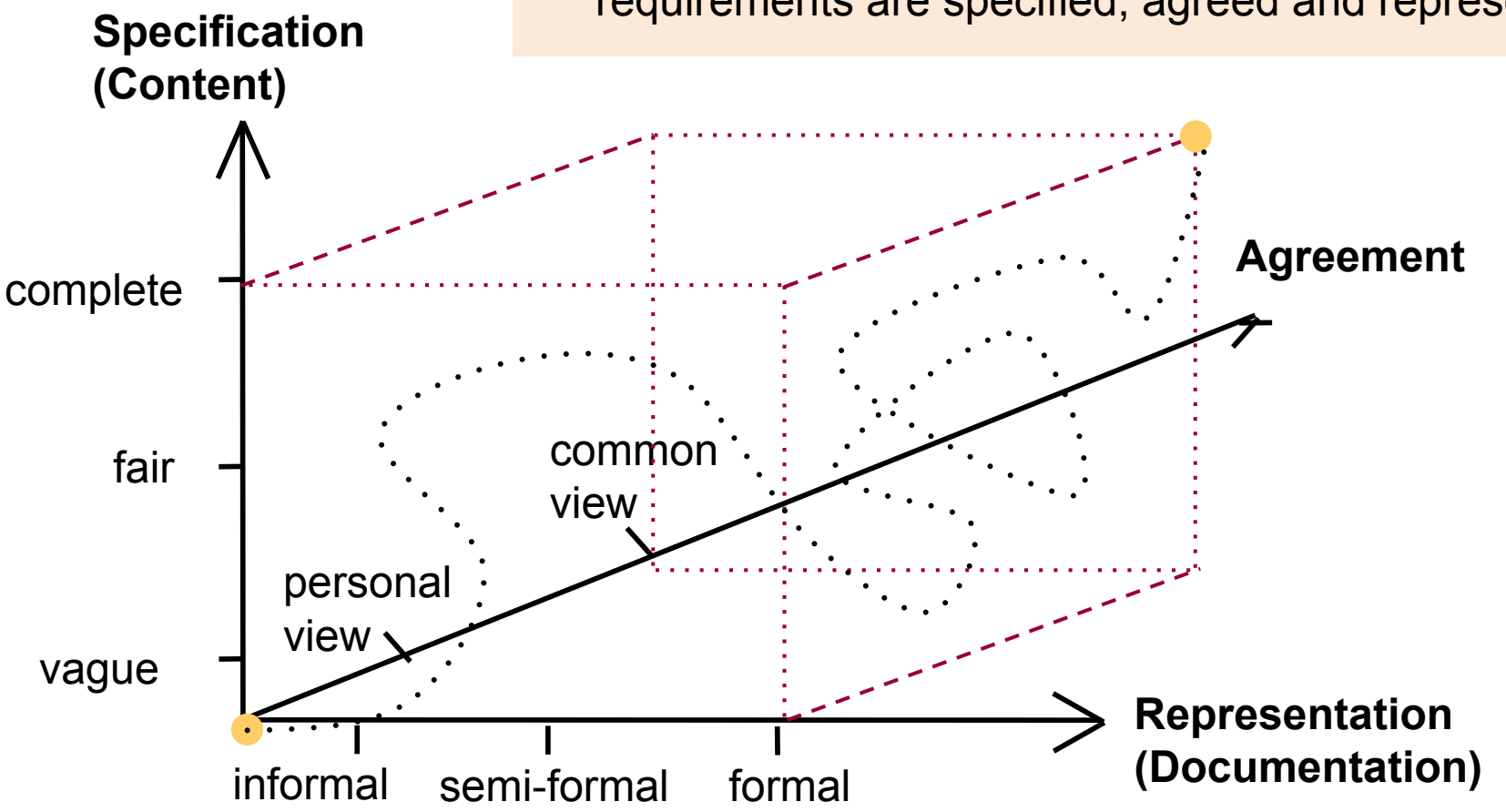
- **Document level**
  - Document – the smallest unit
  - Configurations and document versions created and managed
- **Requirements artefact level**
  - Requirements artefacts – the smallest unit
  - Configurations and artefact versions created and managed
- **Attribute level**
  - Individual attributes of requirements artefacts – the smallest unit
  - Configuration management at the attribute level is typically not realised in practice
    - Too large amount, too complex

配置管理级别

- 文档级别
  - 文档 – 最小单位 – 创建和管理的配置和文档版本
- 要求工件等级
  - 需求工件 – 最小单元 – 创建和管理的配置和工件版本
- 属性等级
  - 需求工件的各个属性 – 最小单元 – 属性级别的配置管理在实践中通常无法实现
    - 数量太大、太复杂

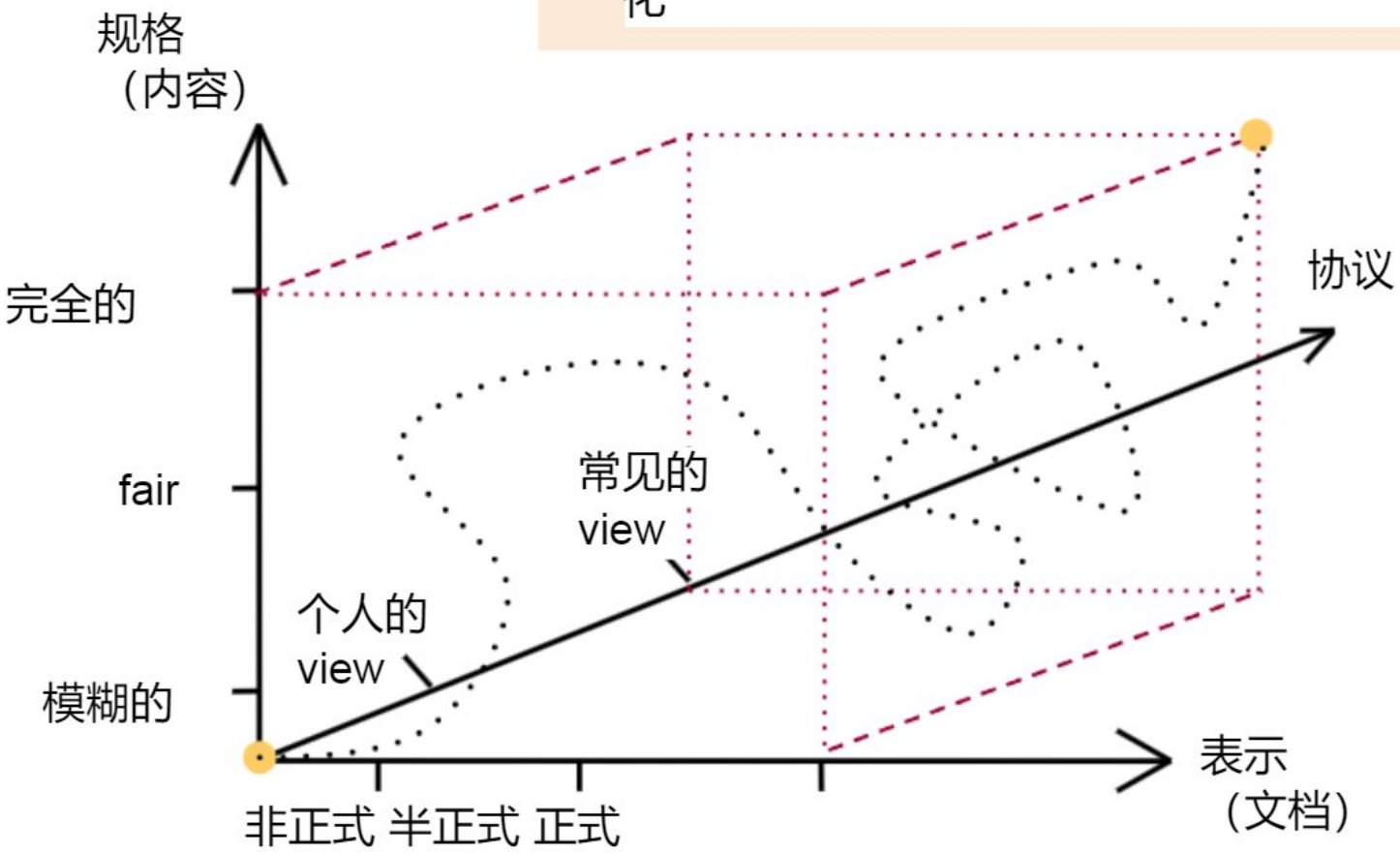
Versions of Requirements Artefact

- Versions changes during the process when requirements are specified, agreed and represented



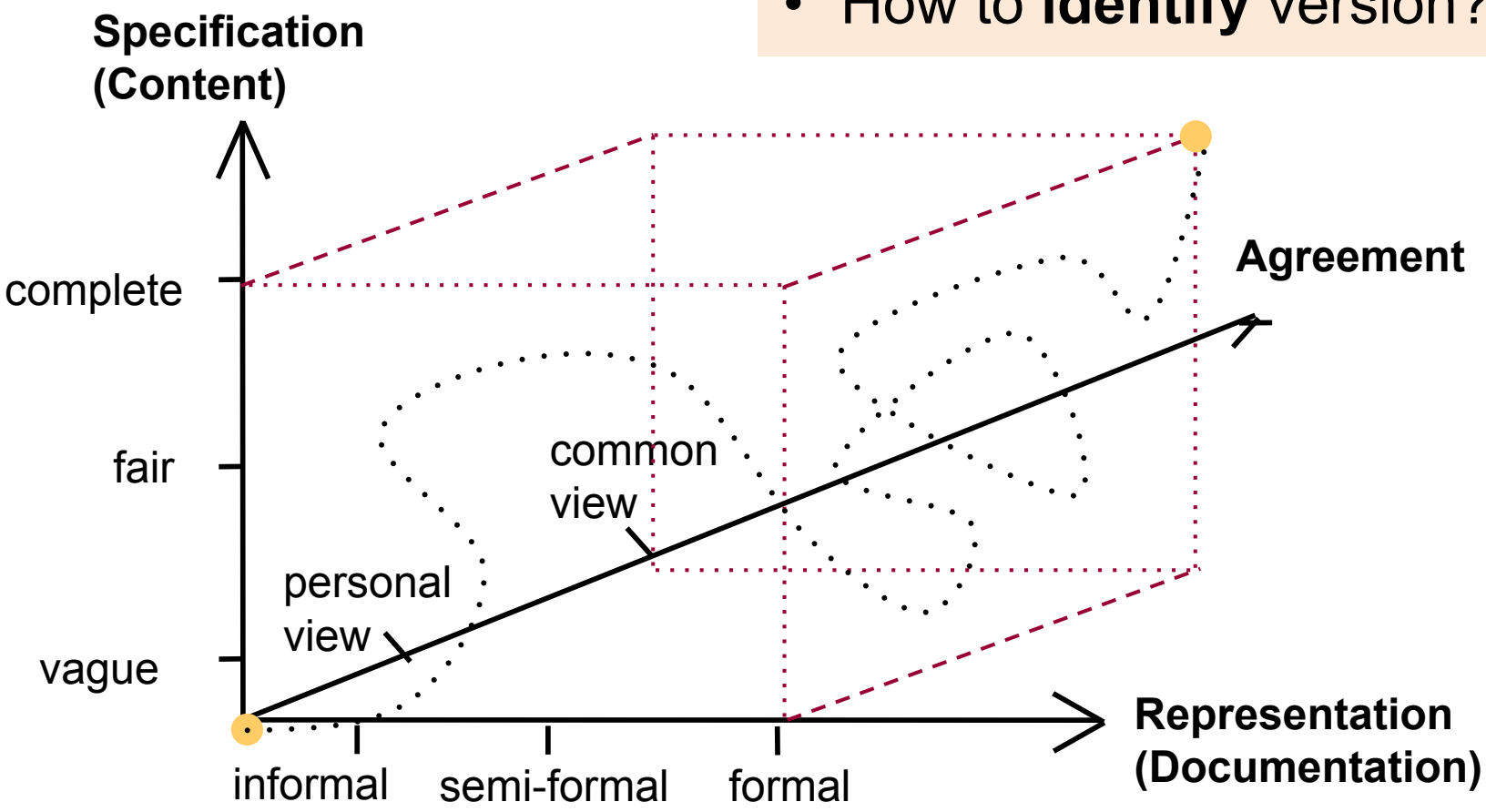
需求工件的版本

- 当需求被指定、商定和表达时，版本会在过程中发生变化



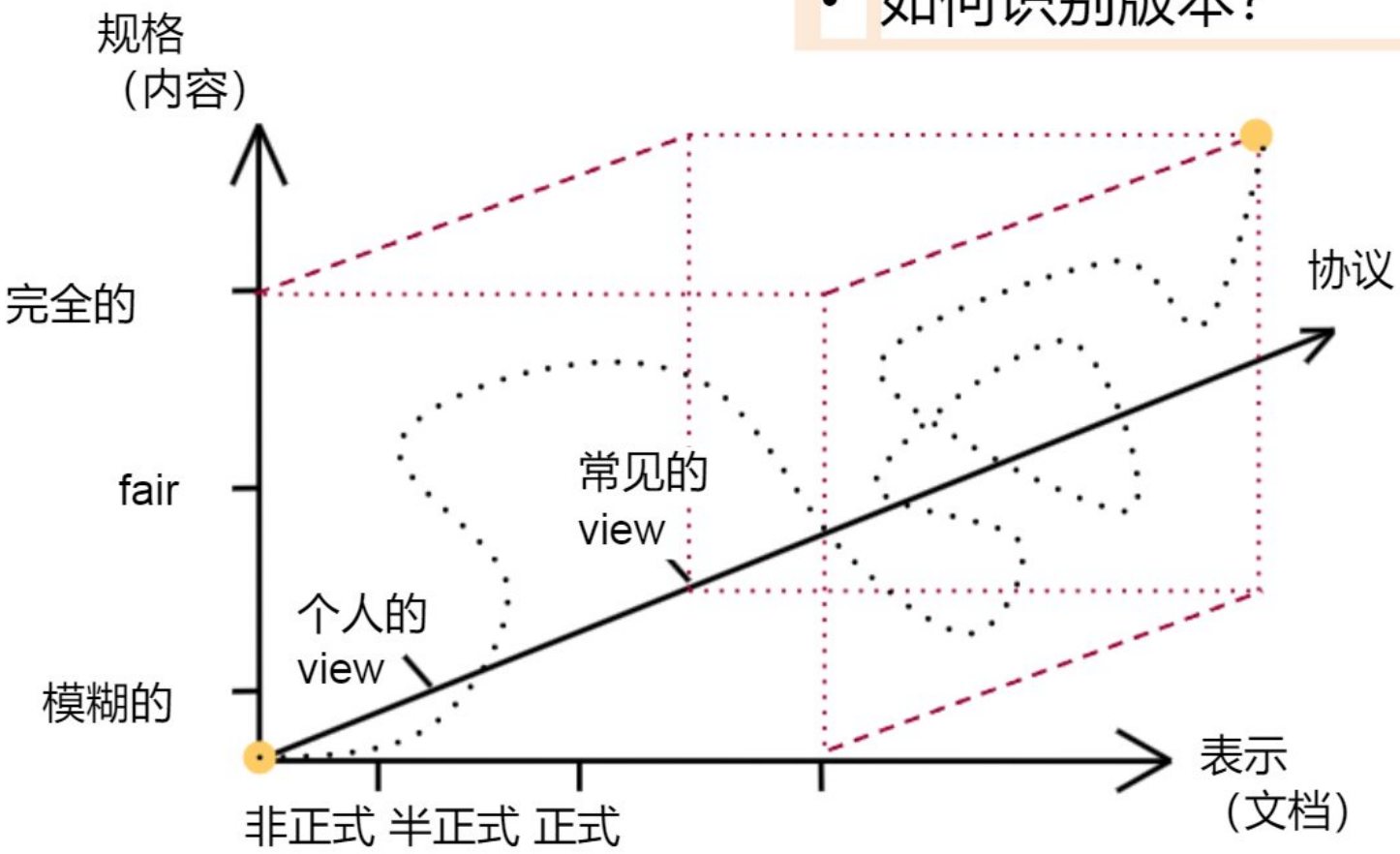
Versions of Requirements Artefact

- How to **identify** version?



需求工件的版本

- 如何识别版本?



Configuration

- Comprises a set of related requirements artefacts – versions of requirements artefacts

  - **Consistency**
    - Version of requirements artefacts grouped together is consistent
  - **Unique identification**
    - To identify configuration unambiguously
  - **Not changeable**
    - Freezes a particular state
    - Changes are not allowed, otherwise – new version
  - **Basis for roll-back**
    - Provide the basis for roll-back to previous states in the process
    - Might be required if changes to the requirements artefacts have led to inconsistencies

配置

- 包含一组相关的需求工件 - 需求工件的版本

- 一致性
  - 组合在一起的需求工件的版本是一致的
- 唯一标识
  - 明确识别配置
- 不可更改
  - 冻结特定状态
  - 不允许更改，否则 – 新版本
- 回滚的基础
  - 为流程中回滚到之前的状态提供基础
  - 如果需求工件的更改导致不一致，则可能需要

Baseline of Requirements Artefacts

- Selected configuration of requirements artefacts
  - Stable requirements artefact versions
  - Realised in a particular system release

  - All properties of configuration and in addition:
    - Basis for the definition of system release
    - Visible to the customer
    - Subject to change management
  - Requirements baseline supports a number of important activities:
    - Basis for planning system release
    - Estimation of realisation effort
    - Comparison with competitor's product

需求基线工件

- 需求工件的选定配置
  - 稳定的需求工件版本 – 在特定的系统版本中实现

- 配置的所有属性，此外：
  - 系统发布定义的基础 • 对客户可见 • 服从变更管理

- 需求基线支持许多重要的活动：
  - 规划系统发布的依据 • 实现工作量的估算
  - 与竞争对手产品的比较

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- 变革管理活动

Why do requirements change?

- Problem encountered during system operation
- Result from a change in the system context

为什么要求会改变?

- 系统操作期间遇到的问题 • 由于系统上下文更改而导致的问题

Requirements change

- **Problem encountered during system operation**
  - Inconsistency
  - System error
  - Unsatisfactory system quality encountered during system operation

R-98: The navigation system shall calculate the estimated duration of a trip.

需求变化

- 系统运行过程中遇到的问题
  - 不一致
  - 系统错误 – 系统运行过程中遇到系统质量不理想的情况

R-98：导航系统应计算预计行程持续时间。

Requirements change

- **Problem encountered during system operation**
  - Inconsistency
  - System error
  - Unsatisfactory system quality encountered during system operation

R-98: The navigation system shall calculate the estimated duration of a trip.
Fit criterion: To calculate the estimated duration, for motorways, an average speed of **120** km/h shall be used

需求变化

- 系统运行过程中遇到的问题
  - 不一致
  - 系统错误 – 系统运行过程中遇到系统质量不理想的情况

R-98：导航系统应计算预计行程持续时间。拟合标准：计算预计持续时间，对于高速公路，应使用 120 km/h 的平均速度

Requirements change

- **Problem encountered during system operation**
  - Inconsistency
  - System error
  - Unsatisfactory system quality encountered during system operation

R-98: The navigation system shall calculate the estimated duration of a trip.
Fit criterion: To calculate the estimated duration, for motorways, an average speed of 120 km/h shall be used

- *The feedback from customers indicated that the estimated driving times are always too optimistic, i.e., in reality, a longer time is needed to reach the destination. To accommodate this feedback and to improve the system, requirement R-98 is changed. Now it defines that the average speed can be changed by the user at any time.*

需求变化

- 系统运行过程中遇到的问题
  - 不一致
  - 系统错误 – 系统运行过程中遇到系统质量不理想的情况

应使用 120 km/h 的平均速度 R-98：导航系统应计算预计行程持续时间。拟合标准：计算预计持续时间，对于高速公路，应使用 120 km/h 的平均速度

- 客户的反馈表明，预计的行车时间总是过于乐观，即实际上需要更长的时间才能到达目的地。为了适应此反馈并改进系统，更改了要求 *R-98*。现在它定义了用户可以随时更改平均速度。

Requirements change

- Problem encountered during system operation
- **Result from a change in the system context**
  - Subject facet
  - Usage facet
  - IT system facet
  - Development facet

需求变化

- 系统运行过程中遇到的问题
- 系统上下文更改的结果
  - 主题方面
  - 使用方面
  - IT系统方面
  - 发展方面

Requirements change

- Problem encountered during system operation
- **Result from a change in the system context**
  - **Subject facet**
  - Usage facet
  - IT system facet
  - Development facet

The manufacturer of the digital roadmap that is used for the navigation system changes the format of the map due to a newly introduced standard for storing geographic data. The new standard defines, among other things, new types of geographic objects. Consequently, the requirements artefacts of navigation system related to reading and processing the map data must be adapted.

需求变化

- 系统运行过程中遇到的问题
- 系统上下文更改的结果
  - 主题方面
  - 使用方面
  - IT系统方面
  - 发展方面

由于新引入的地理数据存储标准，用于导航系统的数字路线图的制造商改变了地图的格式。新标准定义了新的地理对象类型等。因此，必须适应与读取和处理地图数据相关的导航系统的要求。

Requirements change

- Problem encountered during system operation
- **Result from a change in the system context**
  - Subject facet
  - **Usage facet**
  - IT system facet
  - Development facet

Client demanded that the navigation system additionally facilitates voice entry of the destination. Thus, requirements for speed recognition have to be defined and existing “input” requirements for the system have to be adjusted accordingly.

需求变化

- 系统运行过程中遇到的问题
- 系统上下文更改的结果
  - 主题方面
  - 使用方面
  - IT系统方面
  - 发展方面

客户要求导航系统还可以方便地通过语音输入目的地。因此，必须定义速度识别的要求，并且必须相应地调整系统现有的“ 输入” 要求。

Requirements change

- Problem encountered during system operation
- **Result from a change in the system context**
  - Subject facet
  - Usage facet
  - **IT system facet**
  - Development facet

The navigation system interacts with its technical environment (other electronic systems in the vehicle) via an in-vehicle network. The navigation system acquires the current speed and rate of the network interface. As the car manufacturer decides to re-organise the in-vehicle network and use a new network standard, the requirements related to interactions of the navigation system with other electronic systems must be checked and adapted.

需求变化

- 系统运行过程中遇到的问题
- 系统上下文更改的结果
  - 主题方面
  - 使用方面
  - **IT**系统方面
  - 发展方面

导航系统通过车载网络与其技术环境（车辆中的其他电子系统）进行交互。导航系统获取网络接口当前的速度和速率。当汽车制造商决定重新组织车载网络并使用新的网络标准时，必须检查和调整与导航系统与其他电子系统交互相关的要求。

Requirements change

- Problem encountered during system operation
- **Result from a change in the system context**
  - **Development facet**

R-17: In 98% of all cases, the system shall calculate routing information to the destination in less than 1.3 s. Calculating the routing information shall in no cases take more than 2 s.

R-34: The routing calculated by the system shall in no cases contain less than two waypoints per 10 km. For routes with a length of less than 10 km, one waypoint is sufficient.

During design it becomes evident that the performance requirement R-17 and the precision requirement R-34 cannot be fulfilled at the same time, especially in the case of very long trips. This conflict prohibits realising the two requirements as originally specified and results in a change of performance requirement R-17. Thus requirement R-34 is adjusted (not less than two viewpoints per 10 km for trips <300 km and <=1000 km; per 10 km for trips >1000 km)

需求变化

- 系统运行过程中遇到的问题
- 系统上下文更改的结果
  - 发展方面

R-17：在 98% 的情况下，系统应在 1.3 秒内计算到目的地的路由信息。计算路由信息在任何情况下都不应超过 2 秒。

R-34：系统计算的航线在任何情况下每 10 公里不得包含少于两个航路点。对于长度小于 10 公里的航线，一个航点就足够了。

在设计过程中，很明显，性能要求 R-17 和精度要求 R-34 无法同时满足，特别是在很长行程的下。这种冲突阻碍了最初规定的两个要求的实现，并导致性能要求 R-17 发生变化。因此，调整 34 要求（对于 < 300 公里和 < = 1000 公里的行程，每 10 公里不少于两个视点；对于 > 1000 行程，每 10 公里不少于两个视点）

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- 变革管理活动

Change Management Requests

- Integration of a new requirement
- Removal of an existing requirement
- Extension of an existing requirement
- Reduction of an existing requirement
- Change of an existing requirement

变更管理请求

- 整合新需求
- 删除现有要求
- 现有要求的扩展
- 减少现有要求
- 现有要求的变更

Change Management Requests

- **Integration of a new requirement**
  - New requirement elicited and integrated in the requirements baseline
- Removal of an existing requirement
- Extension of an existing requirement
- Reduction of an existing requirement
- Change of an existing requirement

变更管理请求

- 整合新需求
  - 引出新需求并将其集成到需求基线中

- 删除现有要求
- 现有要求的扩展
- 减少现有要求
- 现有要求的变更

Change Management Requests

- Integration of a new requirement
- **Removal of an existing requirement**
  - Existing requirements artefact is invalid and shall be removed from the requirements baseline
- Extension of an existing requirement
- Reduction of an existing requirement
- Change of an existing requirement

变更管理请求

- 整合新需求
- 删除现有要求
  - 现有的需求工件无效，应从需求基线中删除

- 现有要求的扩展
- 减少现有要求
- 现有要求的变更

Change Management Requests

- Integration of a new requirement
- Removal of an existing requirement
- **Extension of an existing requirement**
  - Existing requirements artefact be extended by a particular aspect
  - Extensions be integrated in the requirements baseline
- Reduction of an existing requirement
- Change of an existing requirement

变更管理请求

- 整合新需求
- 删除现有要求
- 现有要求的扩展
  - 现有的需求工件可以通过特定方面进行扩展 – 扩展可以集成到需求基线中
- 减少现有要求
- 现有要求的变更

Change Management Requests

- Integration of a new requirement
- Removal of an existing requirement
- Extension of an existing requirement
- **Reduction of an existing requirement**
  - Some aspects of a requirement shall be removed
  - E.g., particular inputs shall not be processed any more or outputs shall be omitted
- Change of an existing requirement

变更管理请求

- 整合新需求
- 删除现有要求
- 现有要求的扩展
- 减少现有要求
  - 应删除要求的某些方面 – 例如，不应再处理特定输入或应省略输出

- 现有要求的变更

Change Management Requests

- Integration of a new requirement
- Removal of an existing requirement
- Extension of an existing requirement
- Reduction of an existing requirement
- **Change of an existing requirement**
  - A requirement shall be changed in a way that can be classified neither as a single extension nor as a reduction
  - Needs to be integrated in the requirements baseline
  - E.g., modify the assignment of the output value to the input values of a function

变更管理请求

- 整合新需求
- 删除现有要求
- 现有要求的扩展
- 减少现有要求
- 现有要求的变更
  - 需求的更改方式应既不能归类为单一扩展，也不能归类为缩减 – 需要集成到需求基线中 – 例如，修改函数的输出值到输入值的分配

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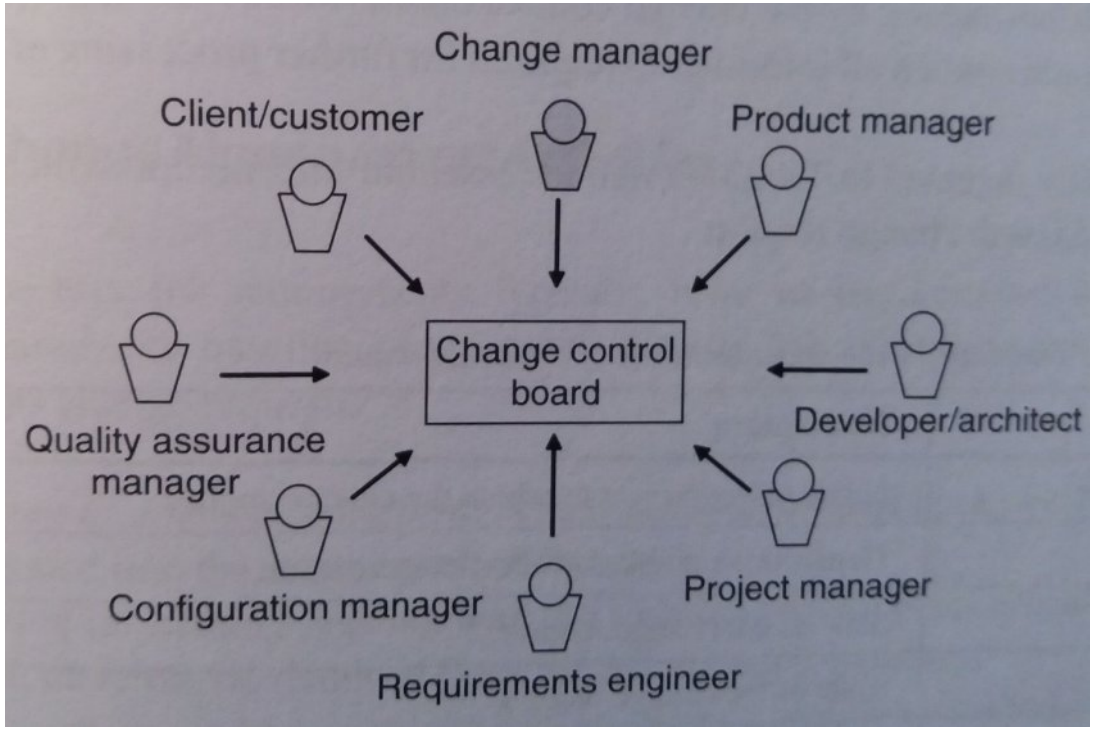
- 变革管理活动

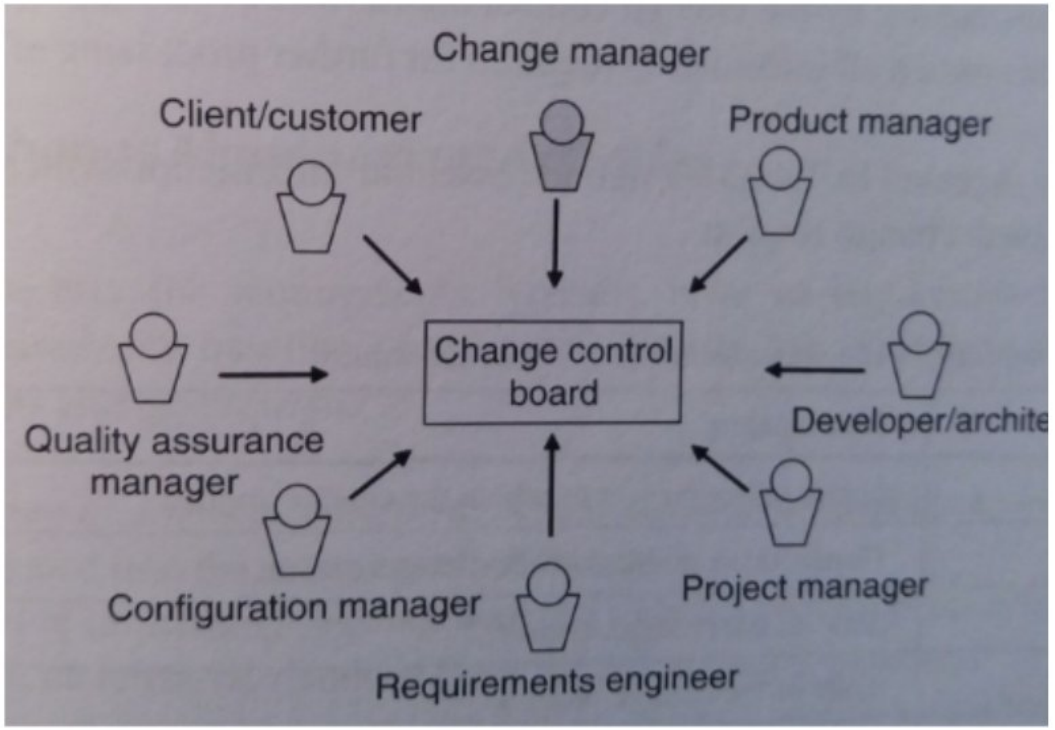
Change Control Board

- Responsibilities
  - **Classification of incoming change requests**
    - Corrective, adaptive, exceptional
  - **Effort estimation for change integration**
    - Impact analysis
  - **Evaluation of change request and decision-making**
    - Relation between effort and benefit
    - Accept or reject
  - **Prioritisation of accepted change requests**



变更控制委员会

- 职责
  - 传入的分类
    变更请求
    - 纠正性、适应性、异常的
  - 努力估计
    变革整合
    - 影响分析
  - 变革评估
    请求和
    决策
    - 努力之间的关系并受益
    - 接受或拒绝
  - 已接受的优先级
    变更请求



Documenting Change Request

Tab. 33-1 *Template for the documentation of a change request*

Content	Description
Project name	Name of the project to which the change applies
Request no.	Consecutive number of the change request
Title	Title of the change request
Date	Date of the change request
Originator	Name of the originator
Origin	Origin of the change (e.g. marketing, management, customer, architectural design, and the context facet(s) from which the change originates)
Status	Current status of the change request (e.g. submitted, evaluated, rejected, to be integrated, verified, finalised)
Originator's priority	Priority of the change request (defined by the originator of the change)
Priority of realisation	Priority of the change request (defined by the change control board)
Verifier of the change	Name of the person responsible for verifying the change after its integration
Date of last update	Date of the last update of the change request
Release	Assignment to the release in which the change shall be integrated
Integration effort	Estimated effort required for change integration
Description of the change request	Textual description of the change request
Comments	Comments relating to the change request, e.g. from other stakeholders, the change control board, etc.

记录变更

要求

Tab. 33-1 *Template for the documentation of a change request*

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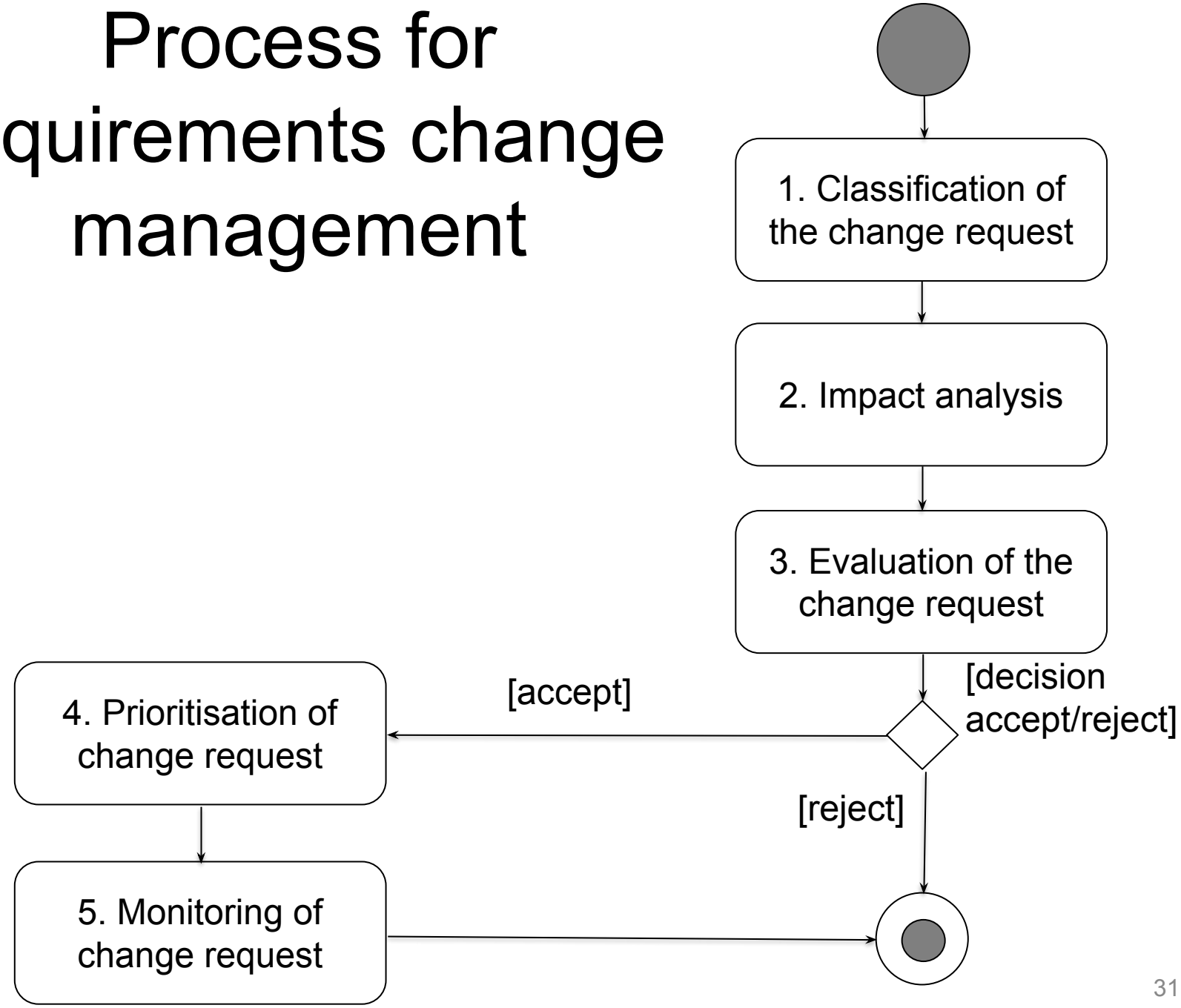
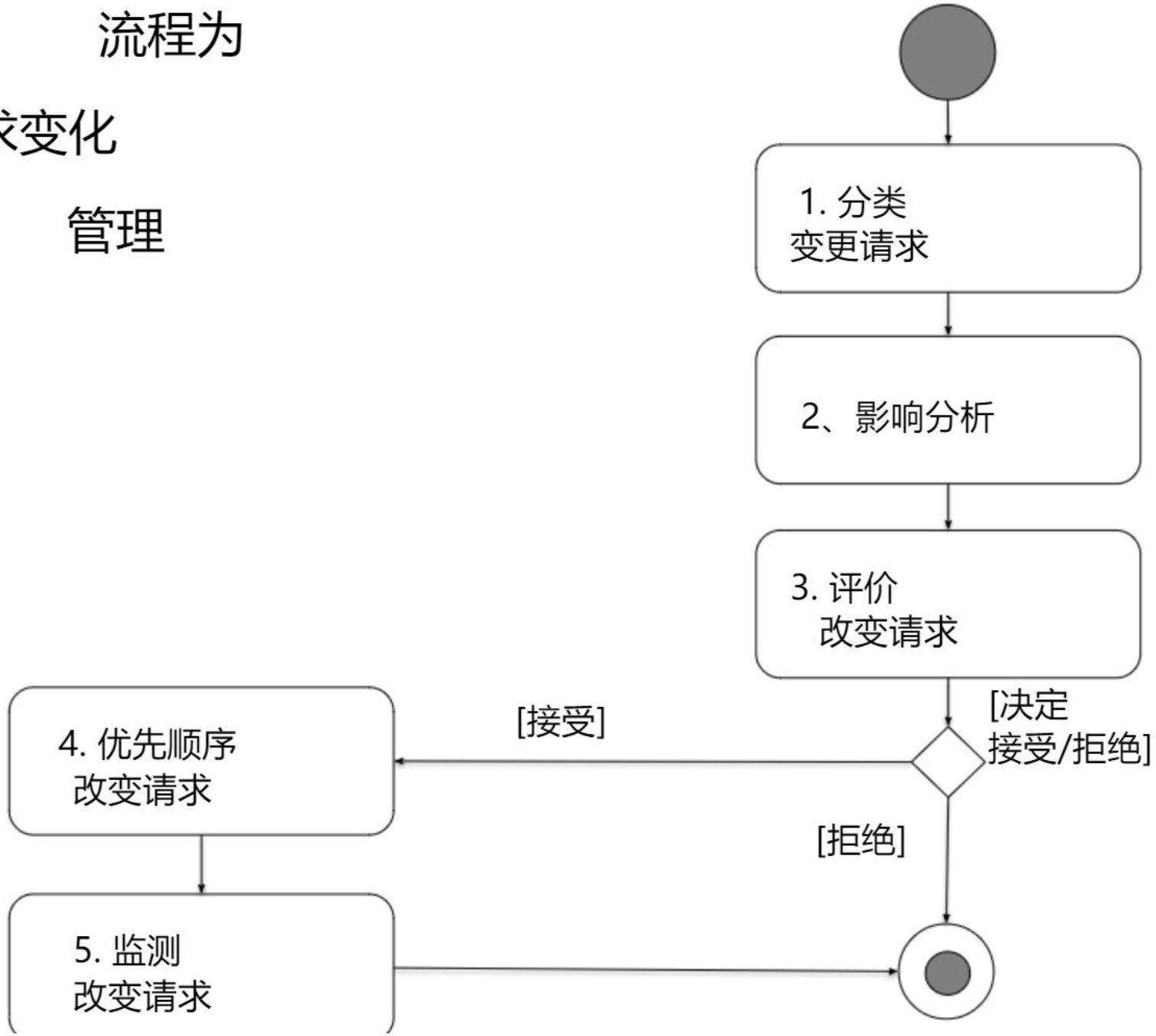
Process for requirements change management



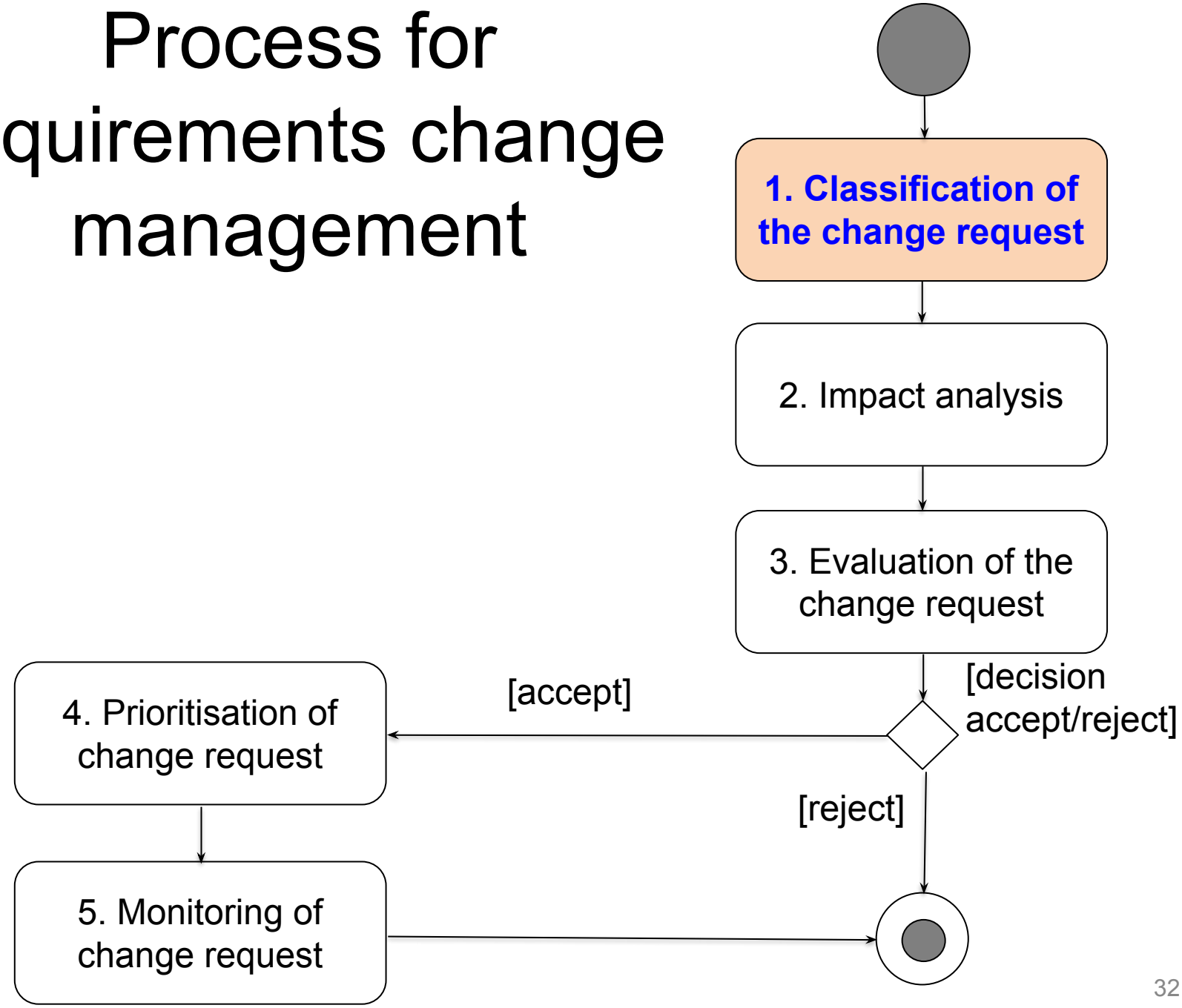
流程为

需求变化

管理



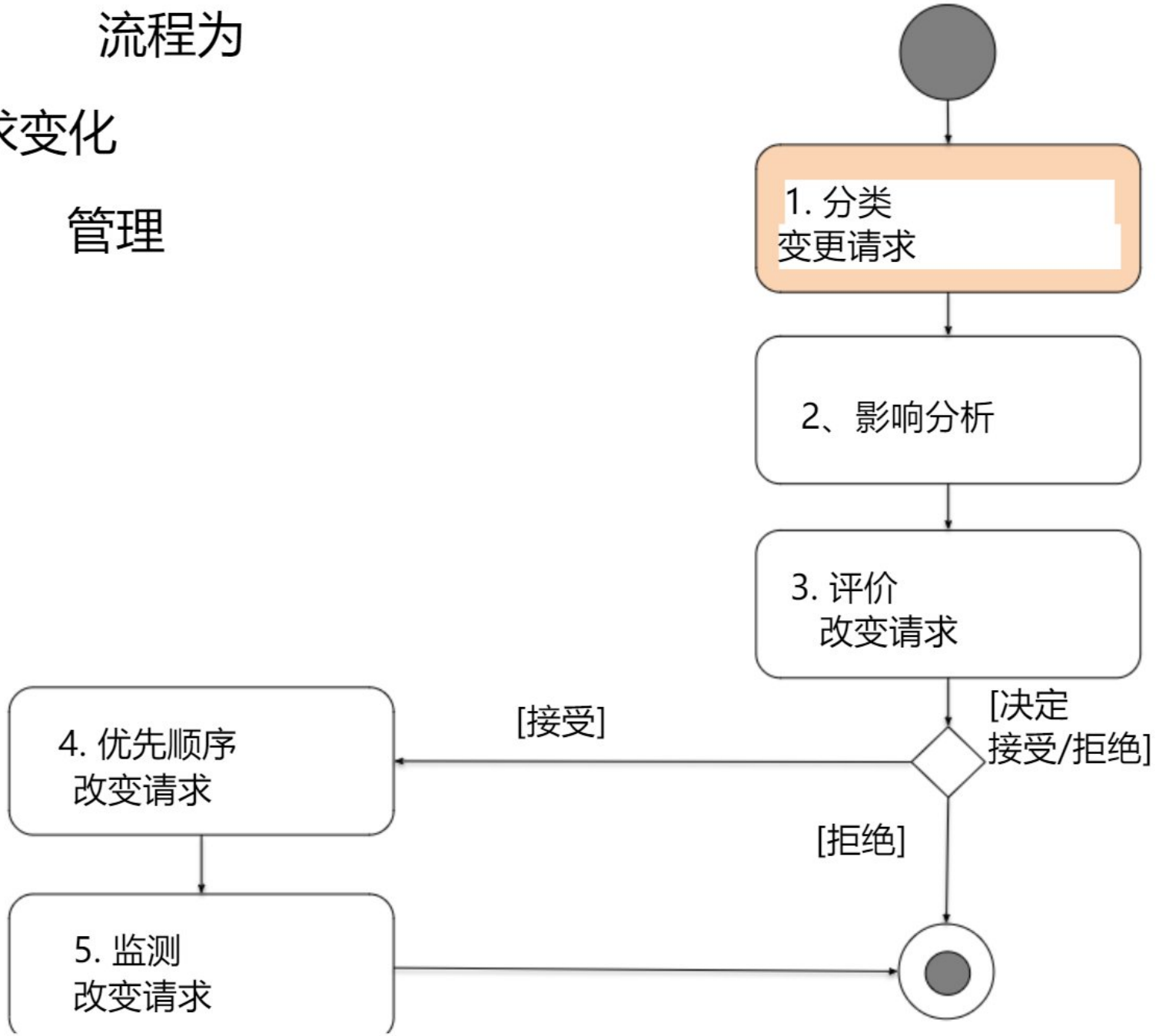
Process for requirements change management



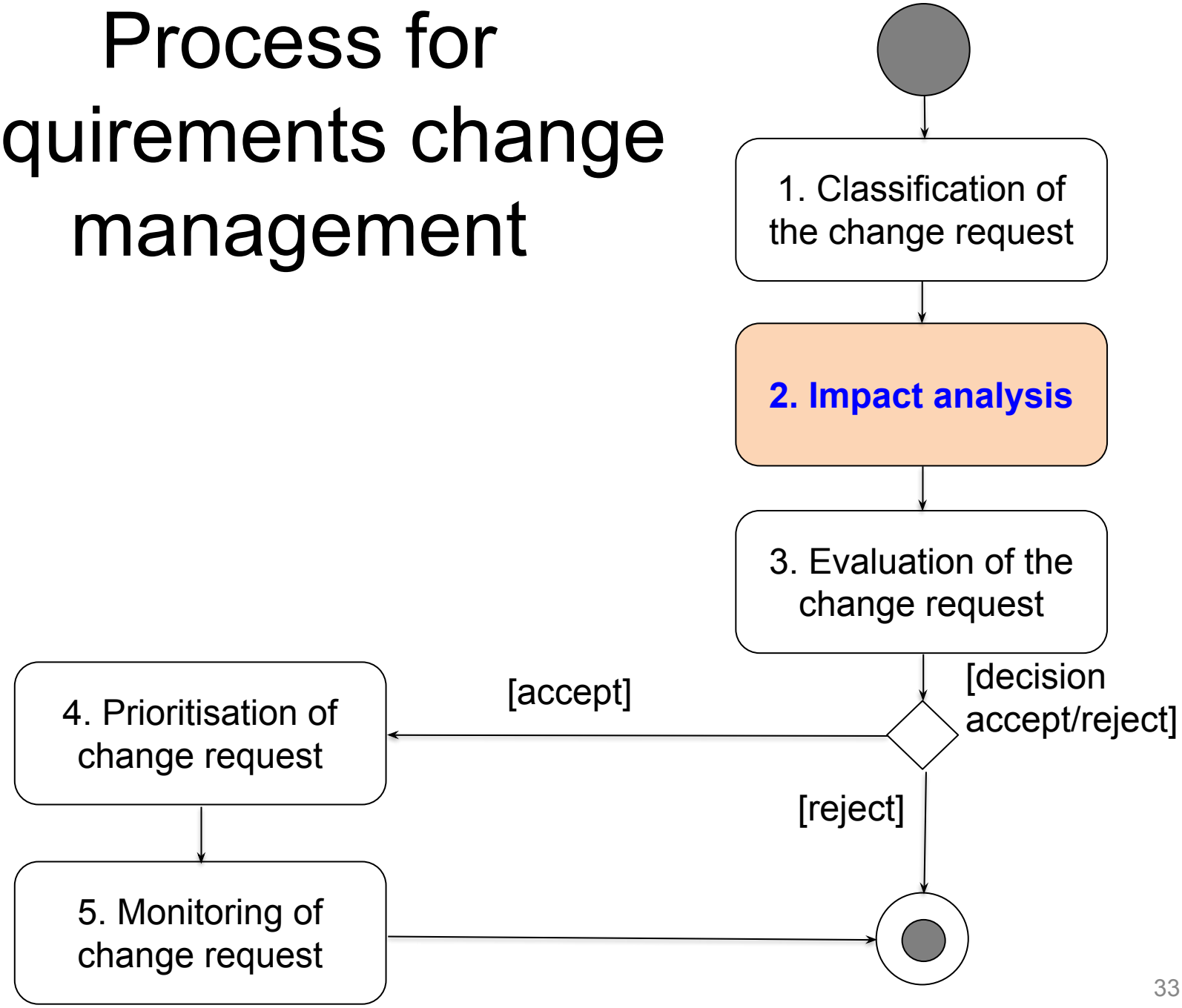
流程为

需求变化

管理



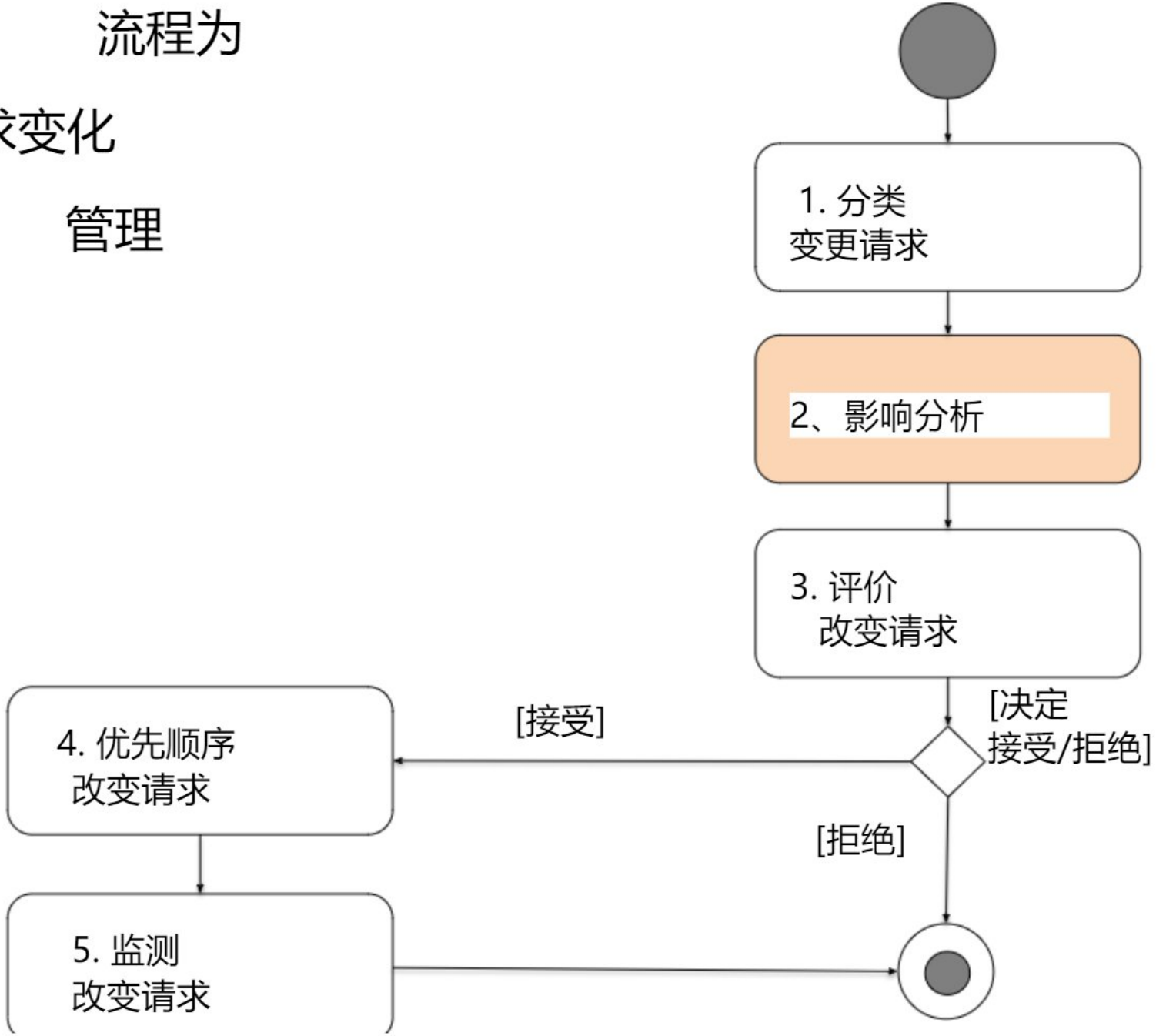
Process for requirements change management



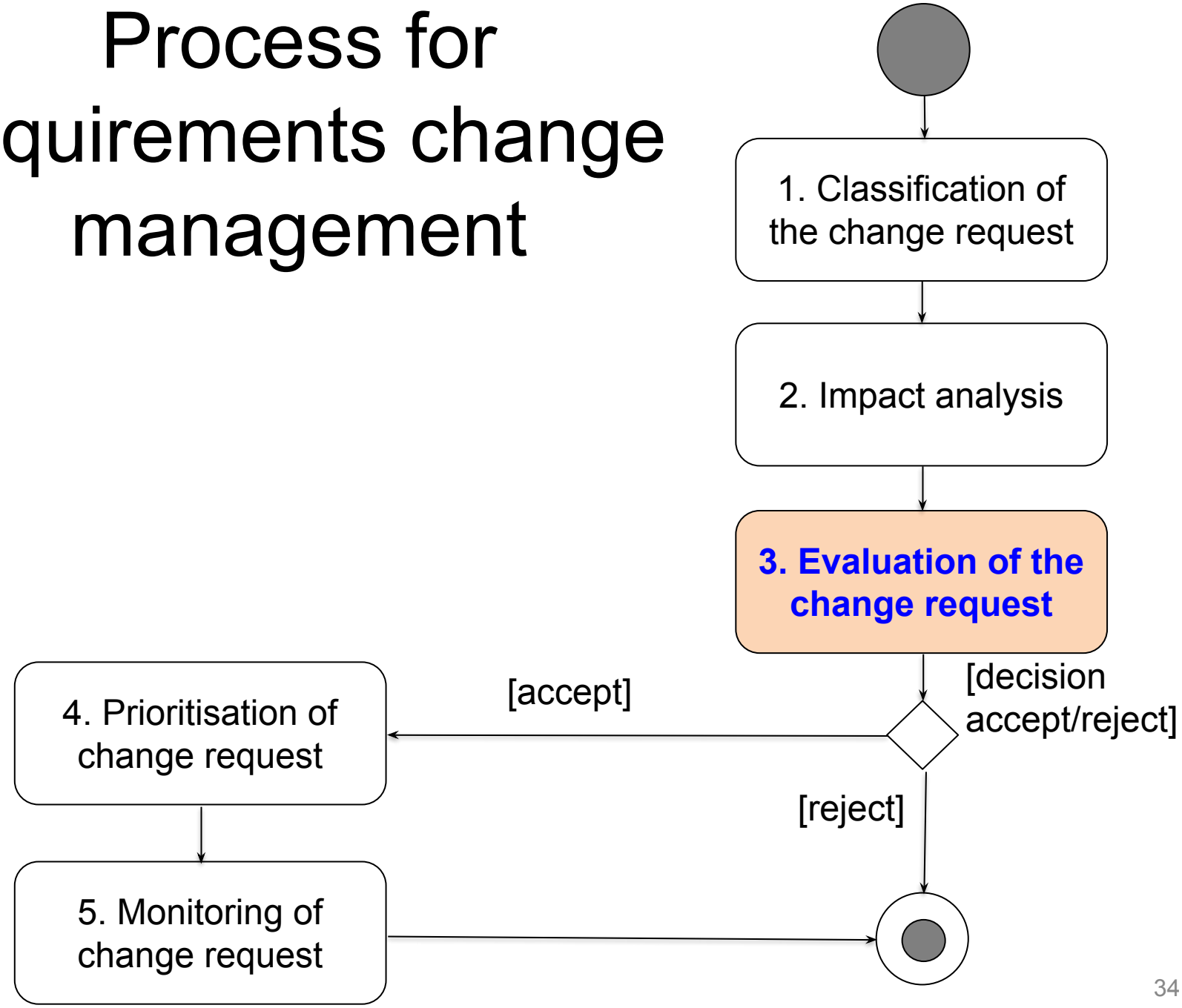
流程为

需求变化

管理



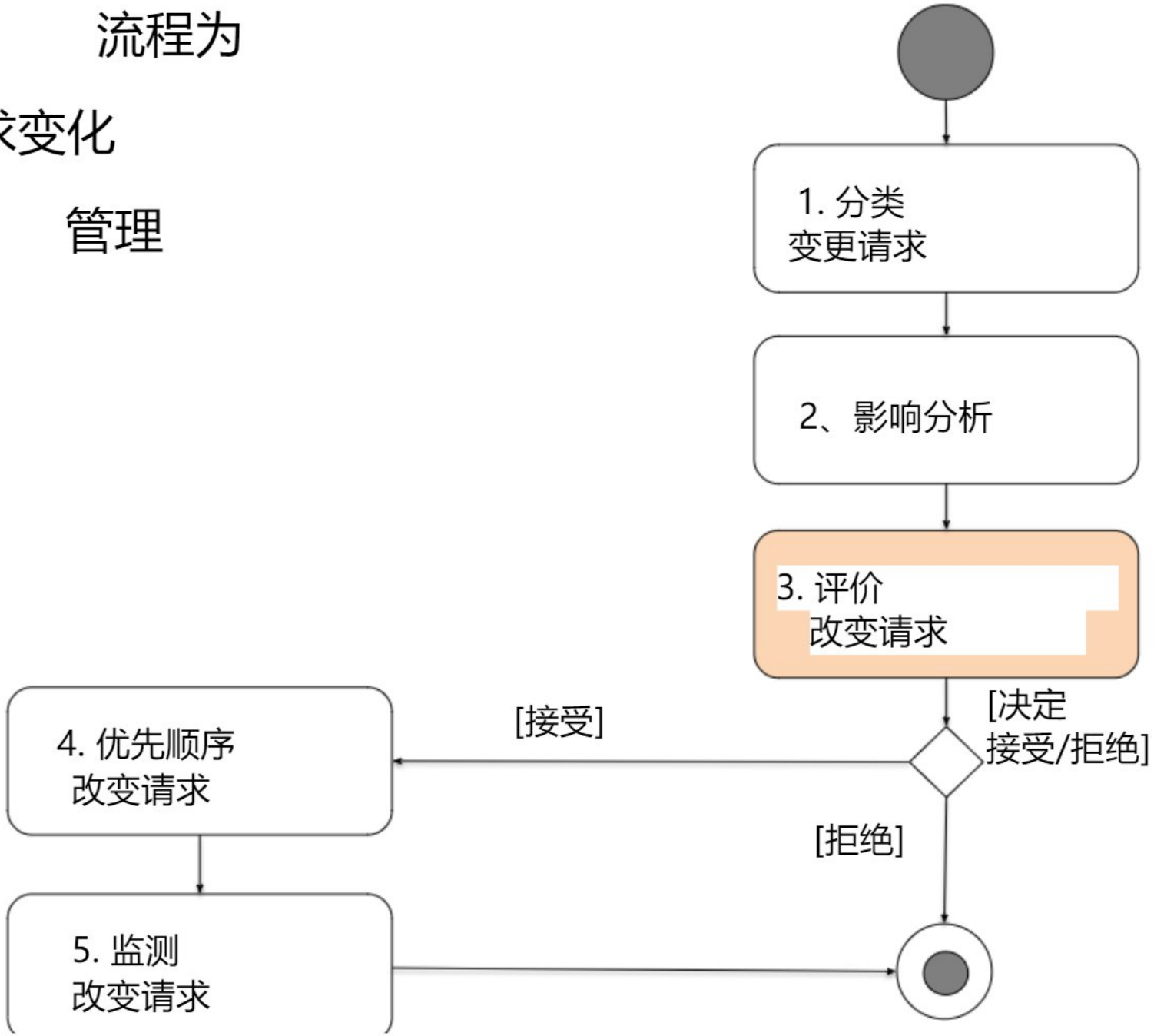
Process for requirements change management



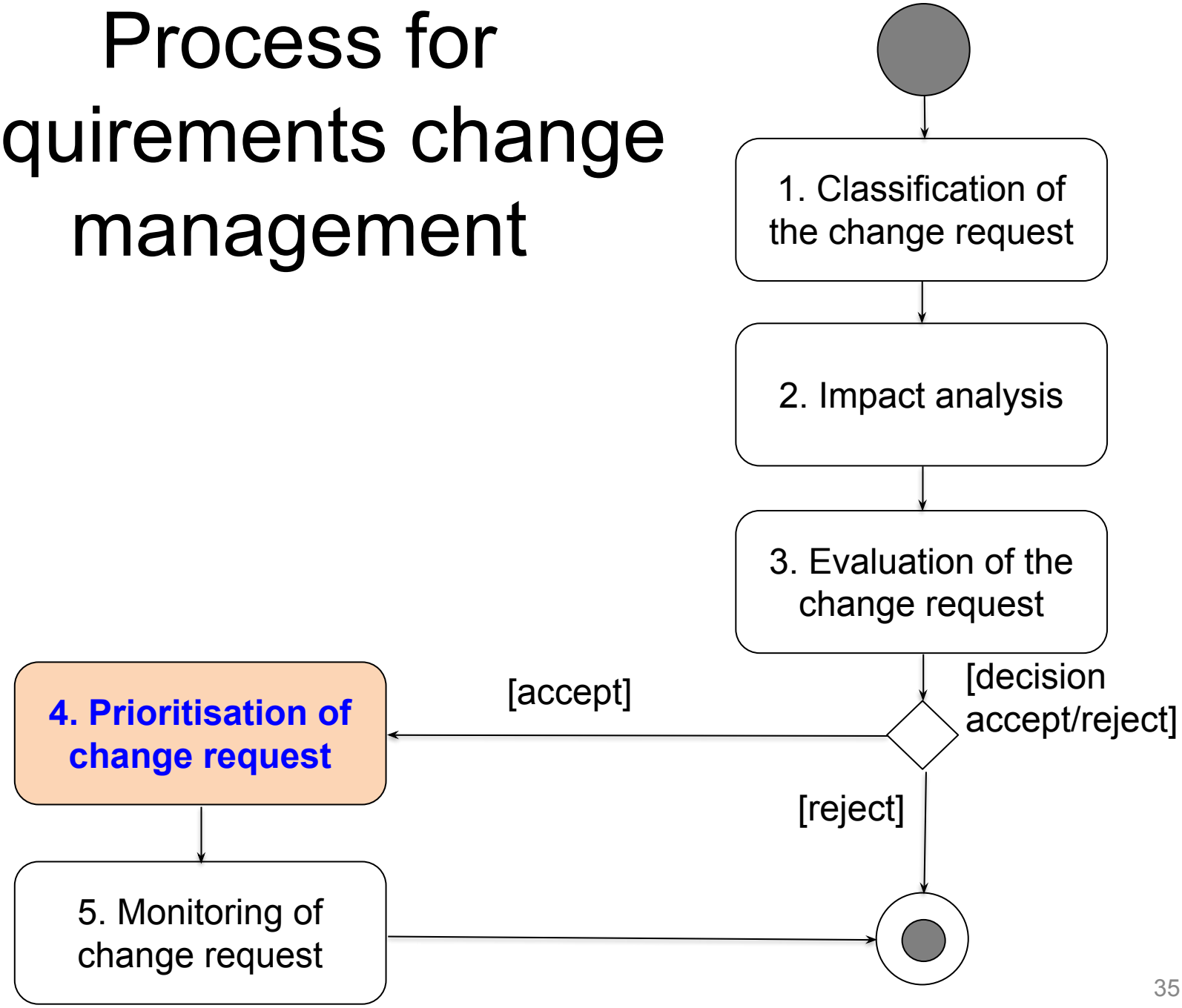
流程为

需求变化

管理



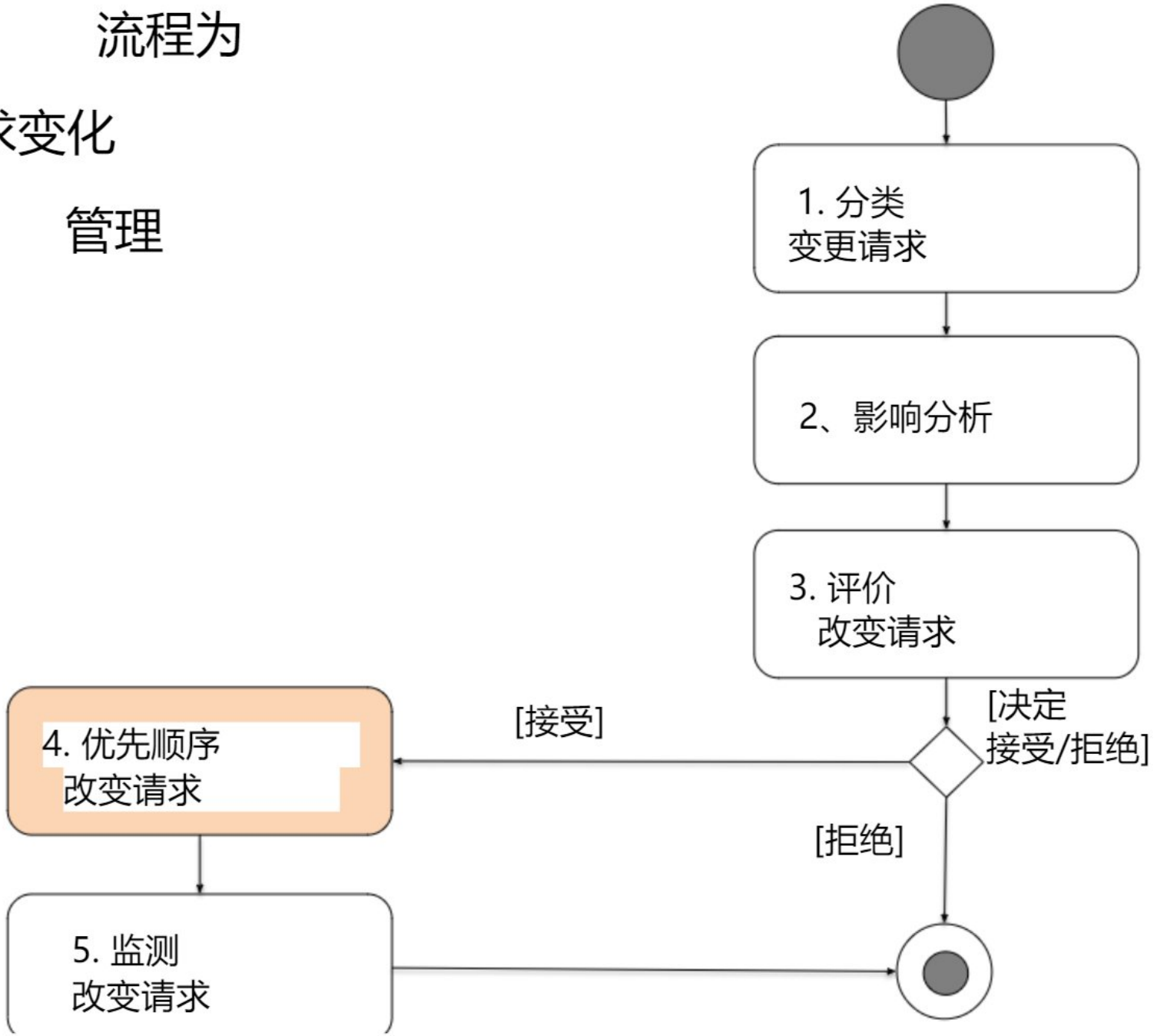
Process for requirements change management



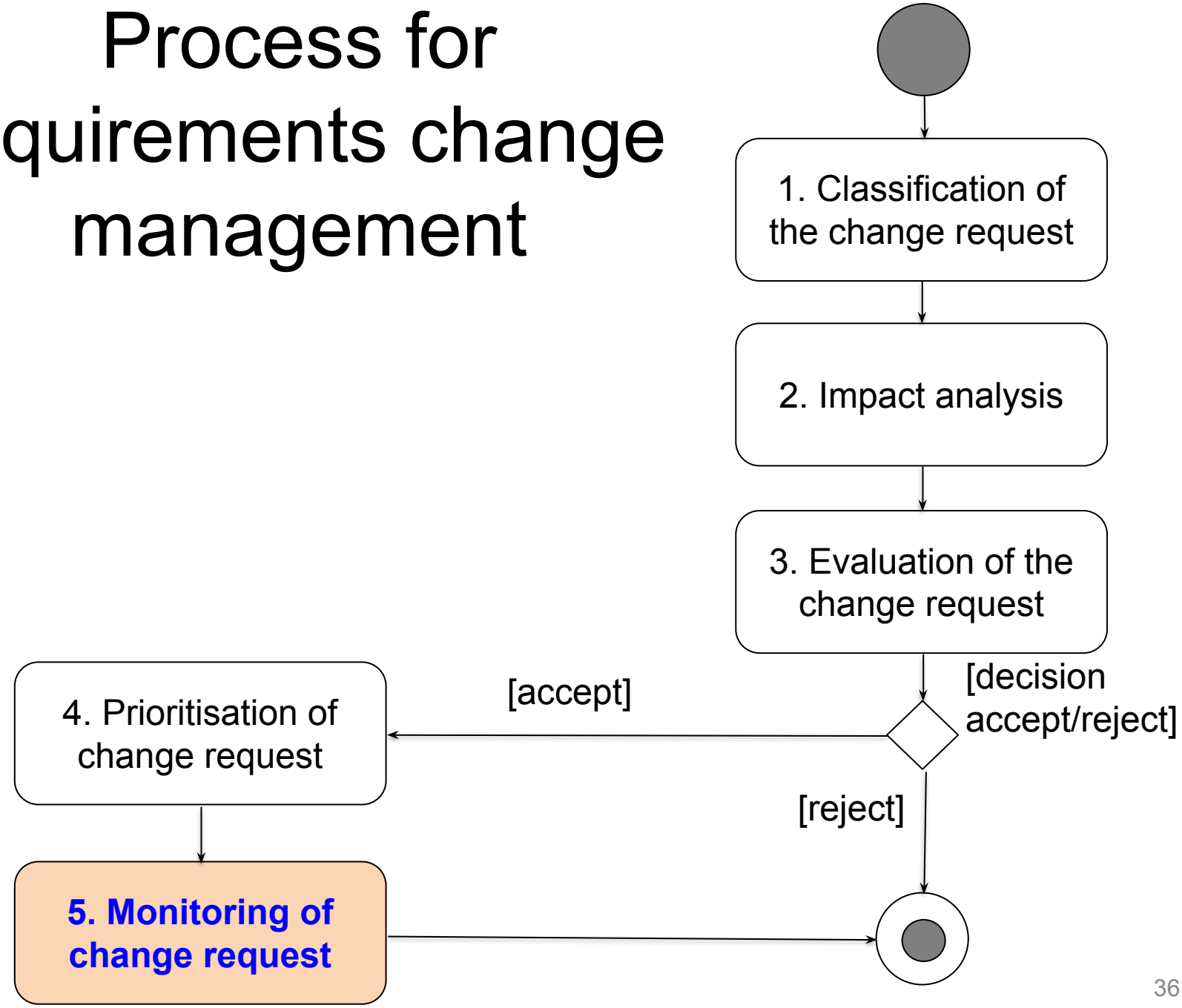
流程为

需求变化

管理



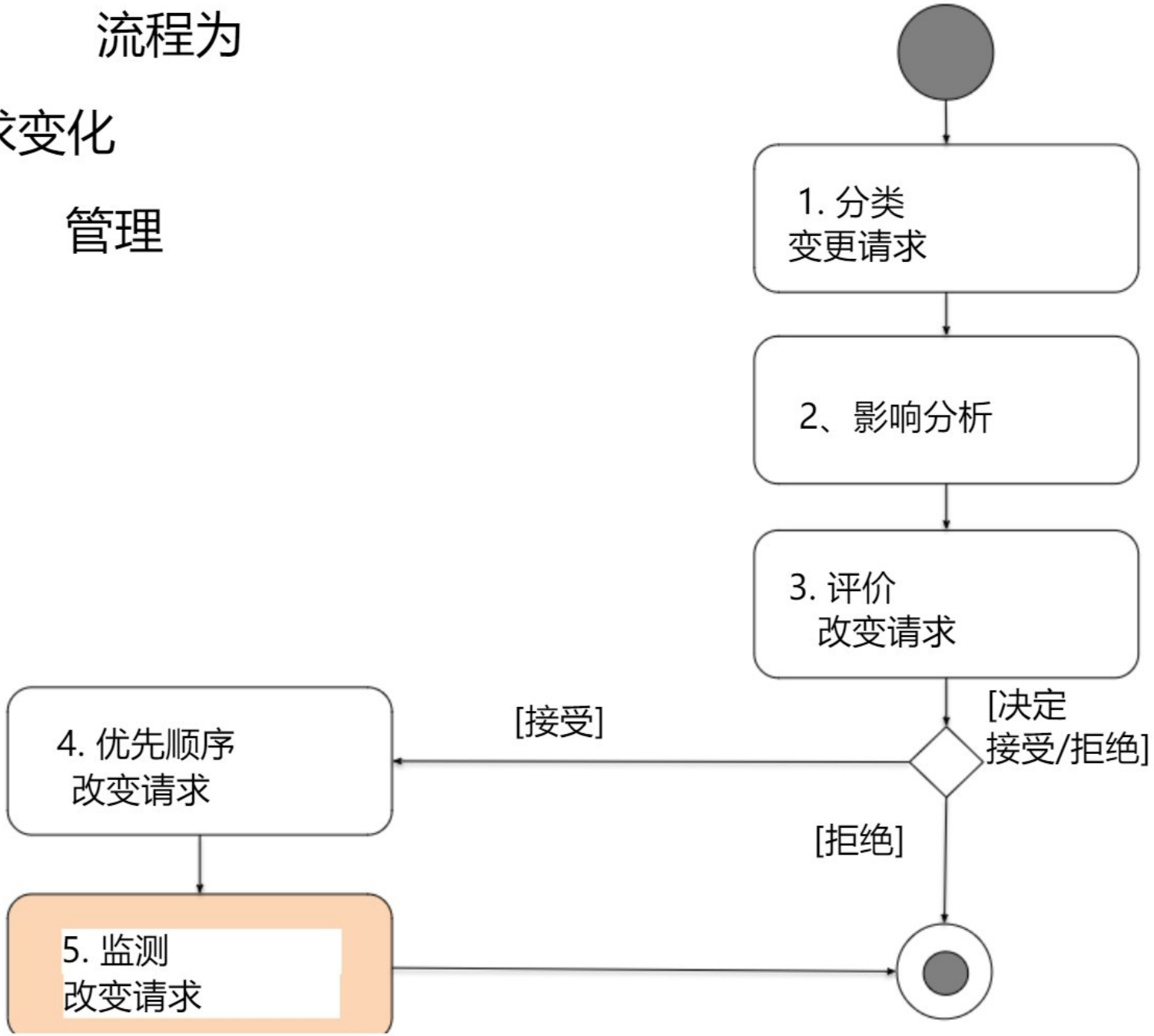
Process for requirements change management



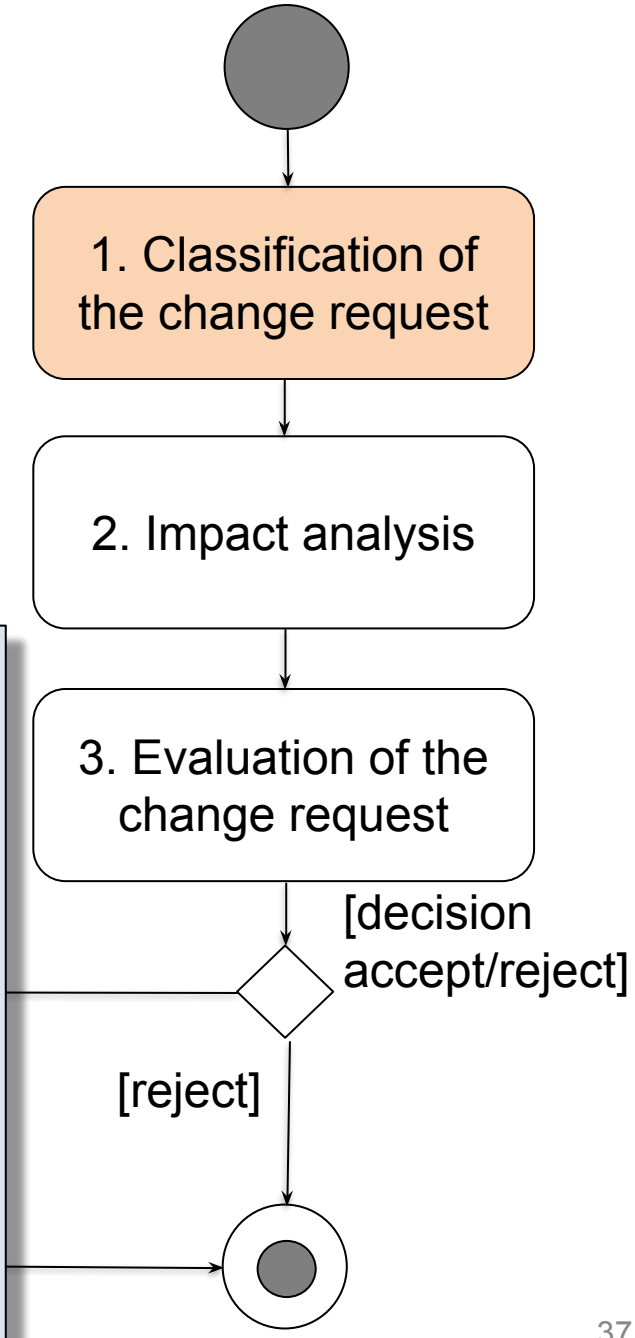
流程为

需求变化

管理



Process for requirements change management



Corrective change

- Cause of change – system error or erroneous behaviour

Adaptive change

- Cause of change – requirements artefact needs to be adapted

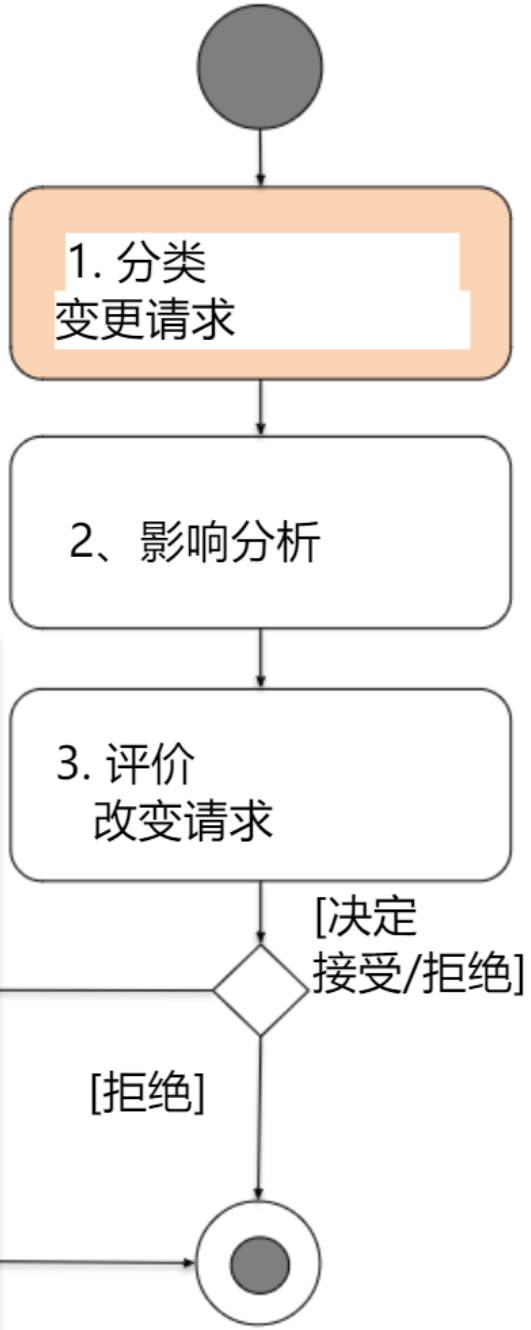
Exceptional change

- Cause of change – it is necessary and must be integrated immediately
  - Can be prioritised among other
  - The change request may be corrective or adaptive

流程为

需求变化

管理



纠正性改变

- 变化原因——系统错误或错误行为

适应性变化

- 变更原因——需求工件需要调整 [接受]

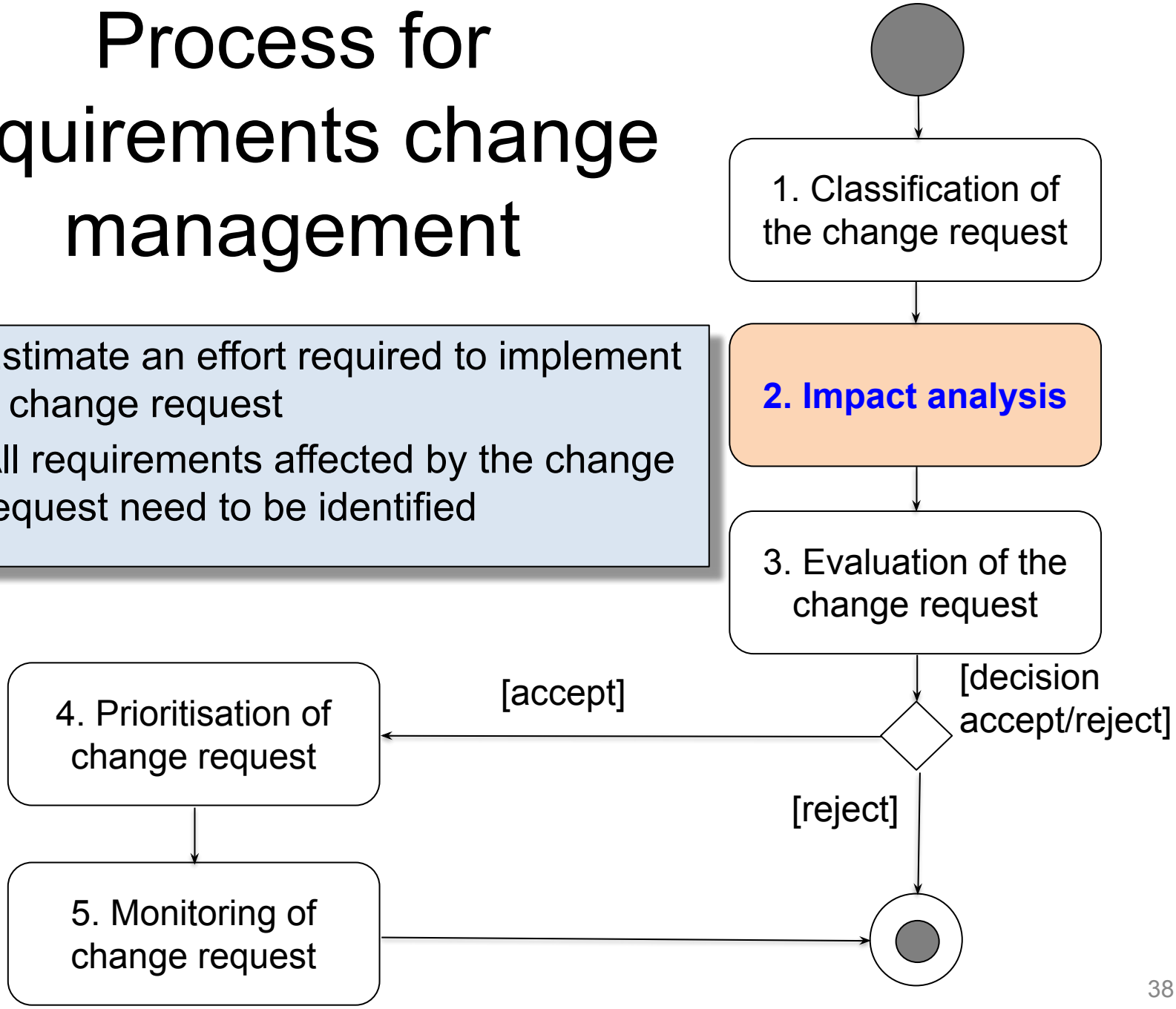
非凡的改变

- 变更原因——有必要且必须立即整合

– 可以优先考虑– 变更请求可以是纠正性的或适应性的

Process for requirements change management

- Estimate an effort required to implement a change request
- All requirements affected by the change request need to be identified

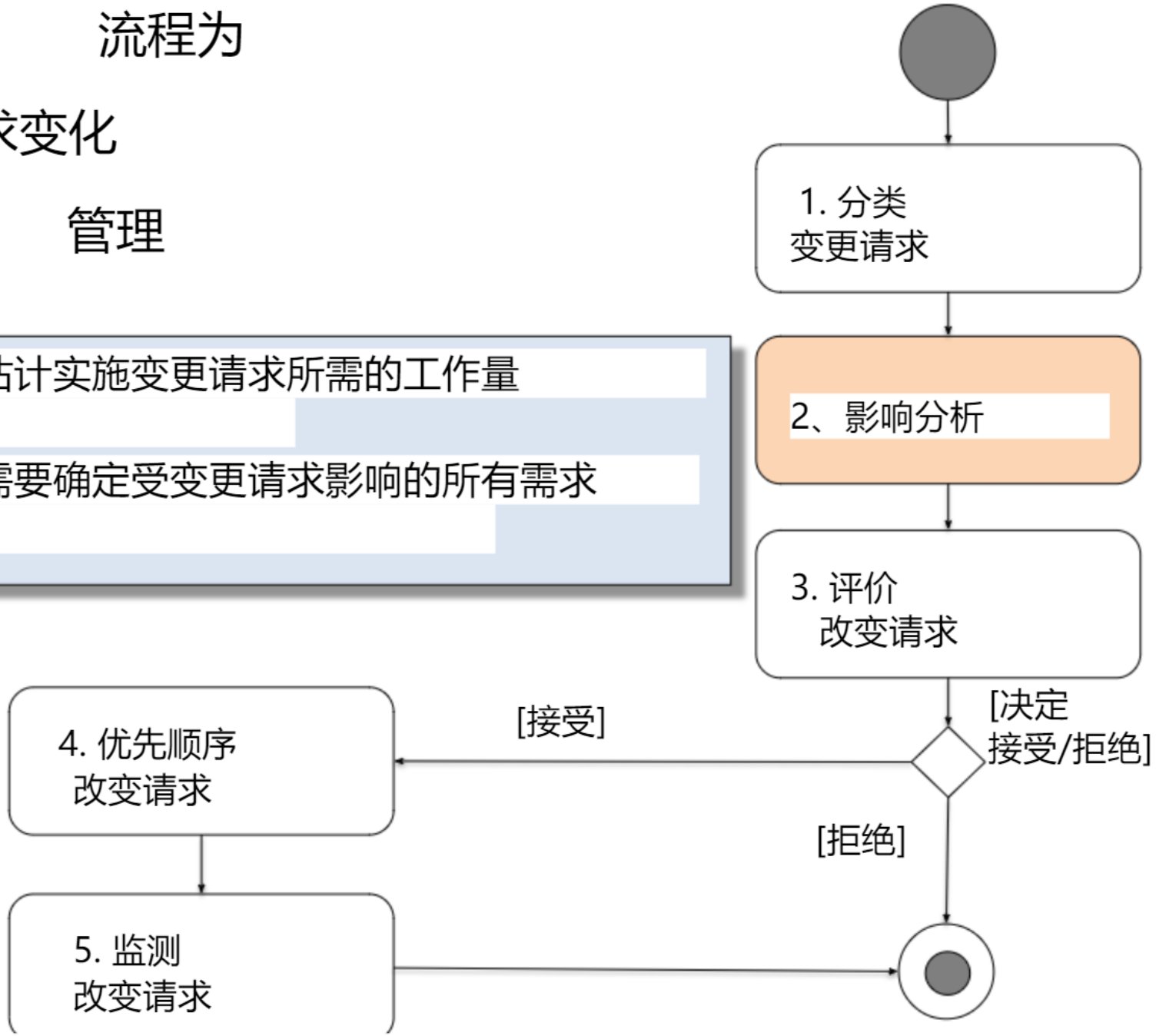


流程为

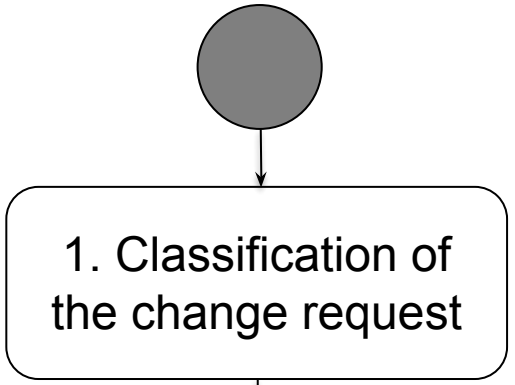
需求变化

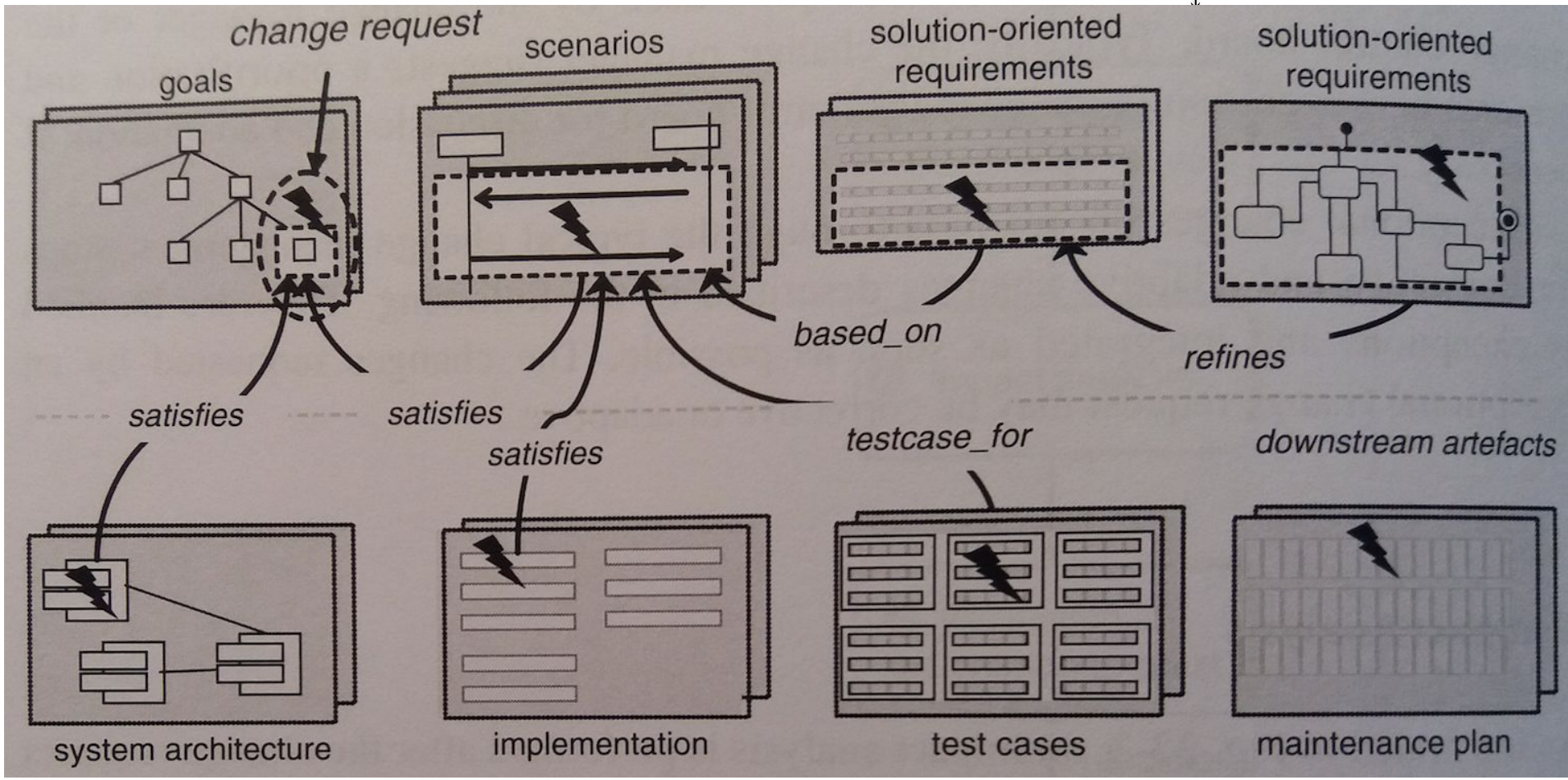
管理

- 估计实施变更请求所需的工作量
- 需要确定受变更请求影响的所有需求



Process for requirements change management

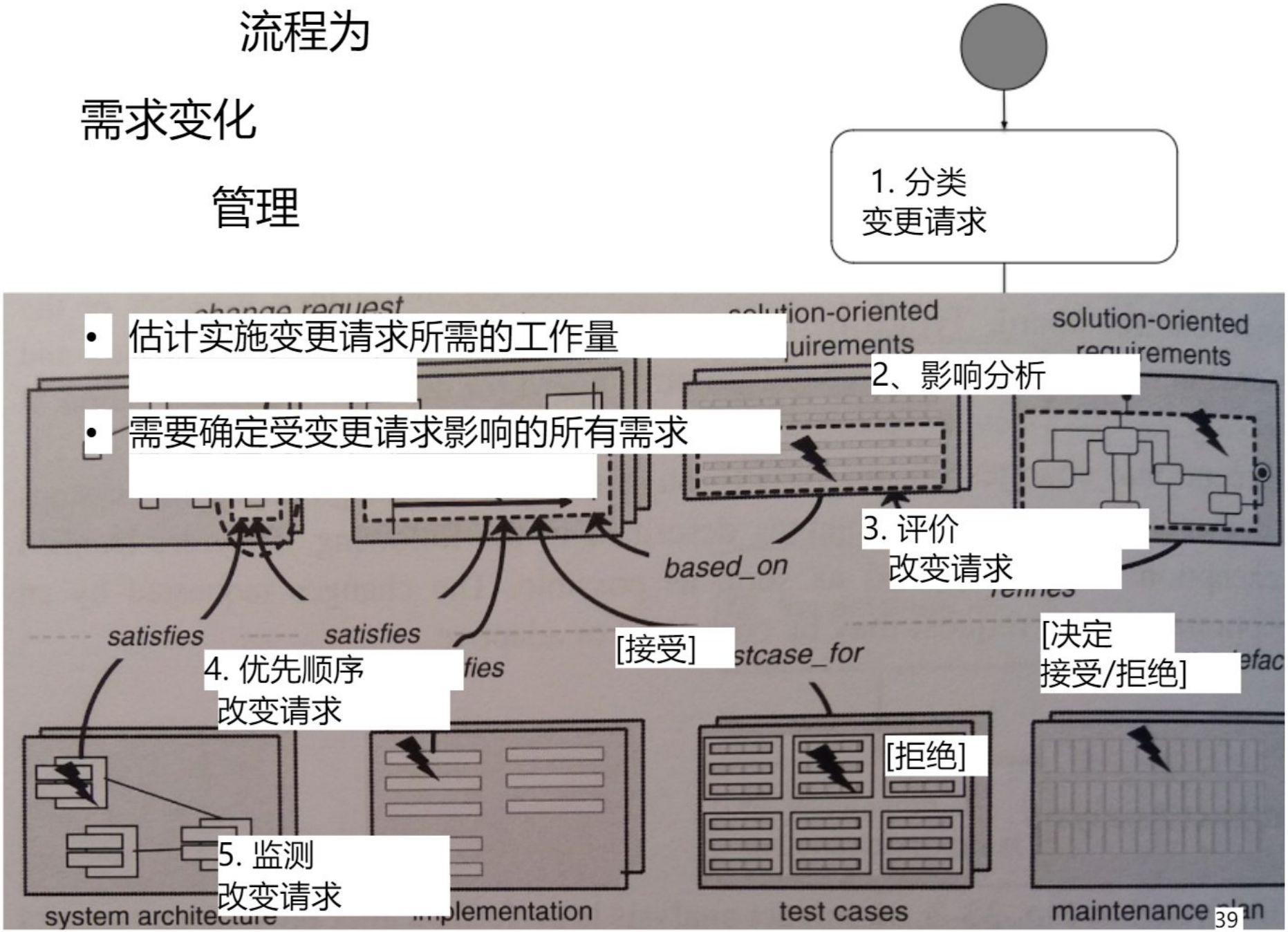




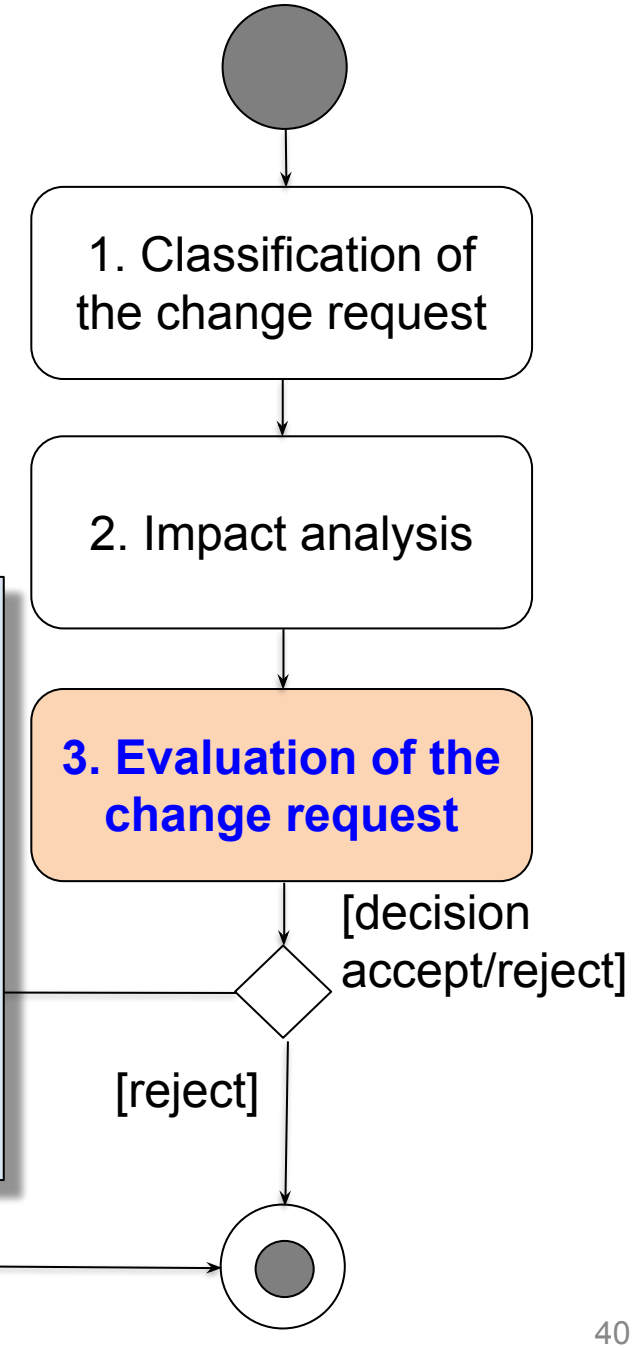
流程为

需求变化

管理


1. 分类
变更请求
• 估计实施变更请求所需的工作量
• 需要确定受变更请求影响的所有需求
2、影响分析
3. 评价
改变请求
[接受]
[决定
接受/拒绝]
[拒绝]
4. 优先顺序
改变请求
5. 监测
改变请求
satisfies
satisfies
based_on
solution-oriented
solution-oriented
system architecture
test cases
maintenance

Process for requirements change management

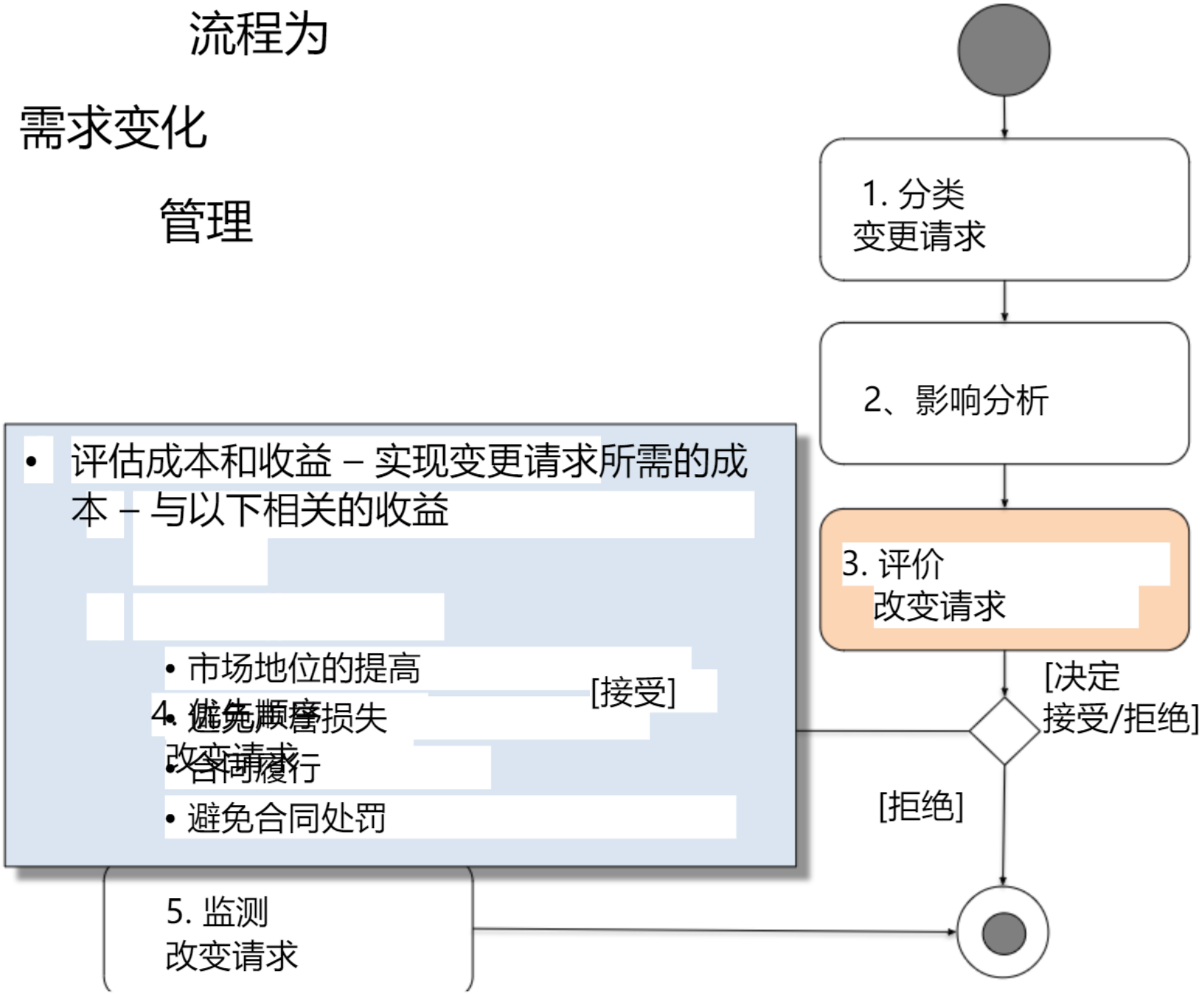


- Evaluates cost and the benefit
  - **Cost** required to realise the change request
  - **Benefit** related to
    - Improvement in market position
    - Avoidance of loss of prestige
    - Contract fulfillment
    - Avoidance of contractual penalties

流程为

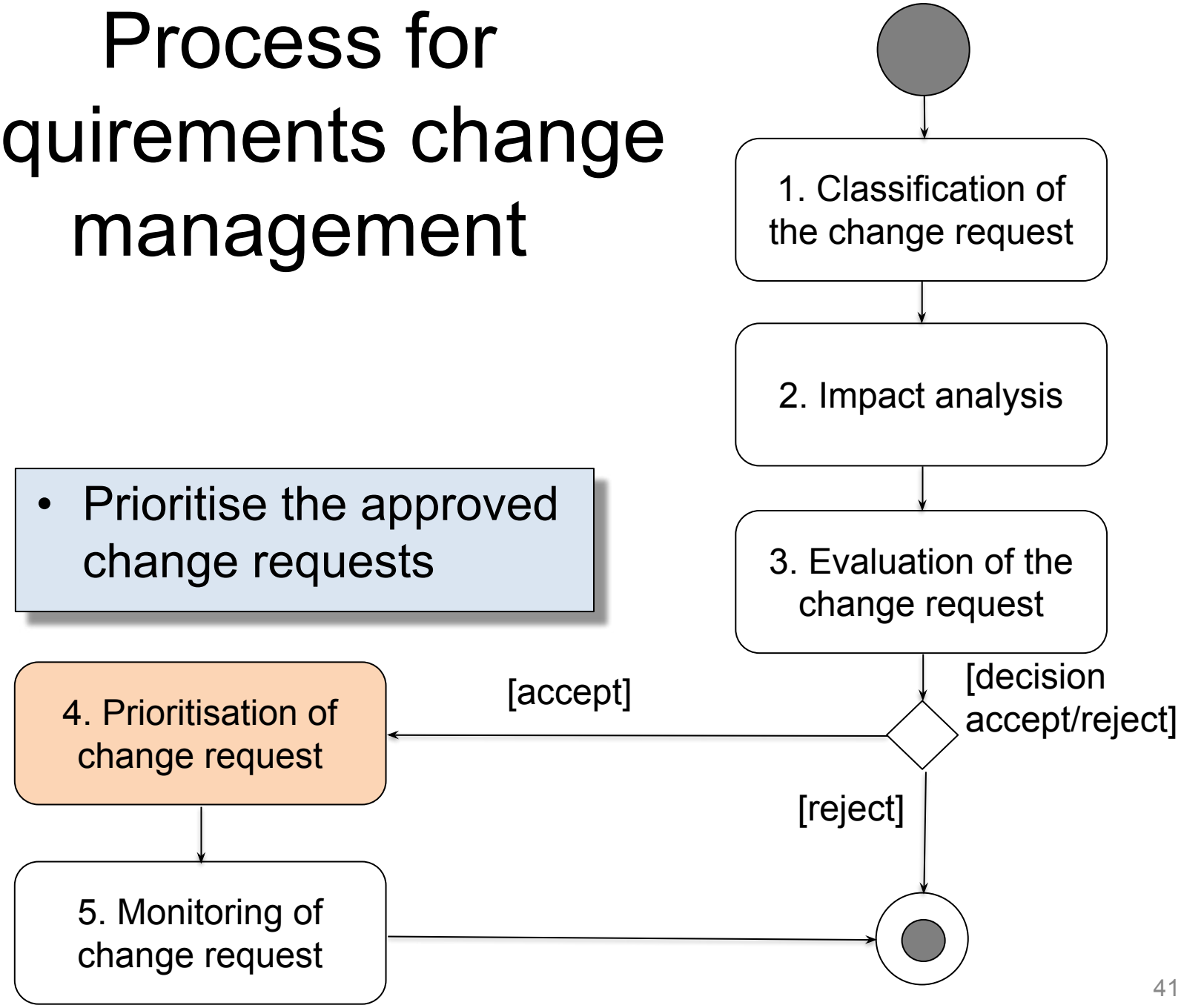
需求变化

管理



- 评估成本和收益 – 实现变更请求所需的成本 – 与以下相关的收益
  - 市场地位的提高
  - 避免/减少损失
  - 合同履行
  - 避免合同处罚

Process for requirements change management

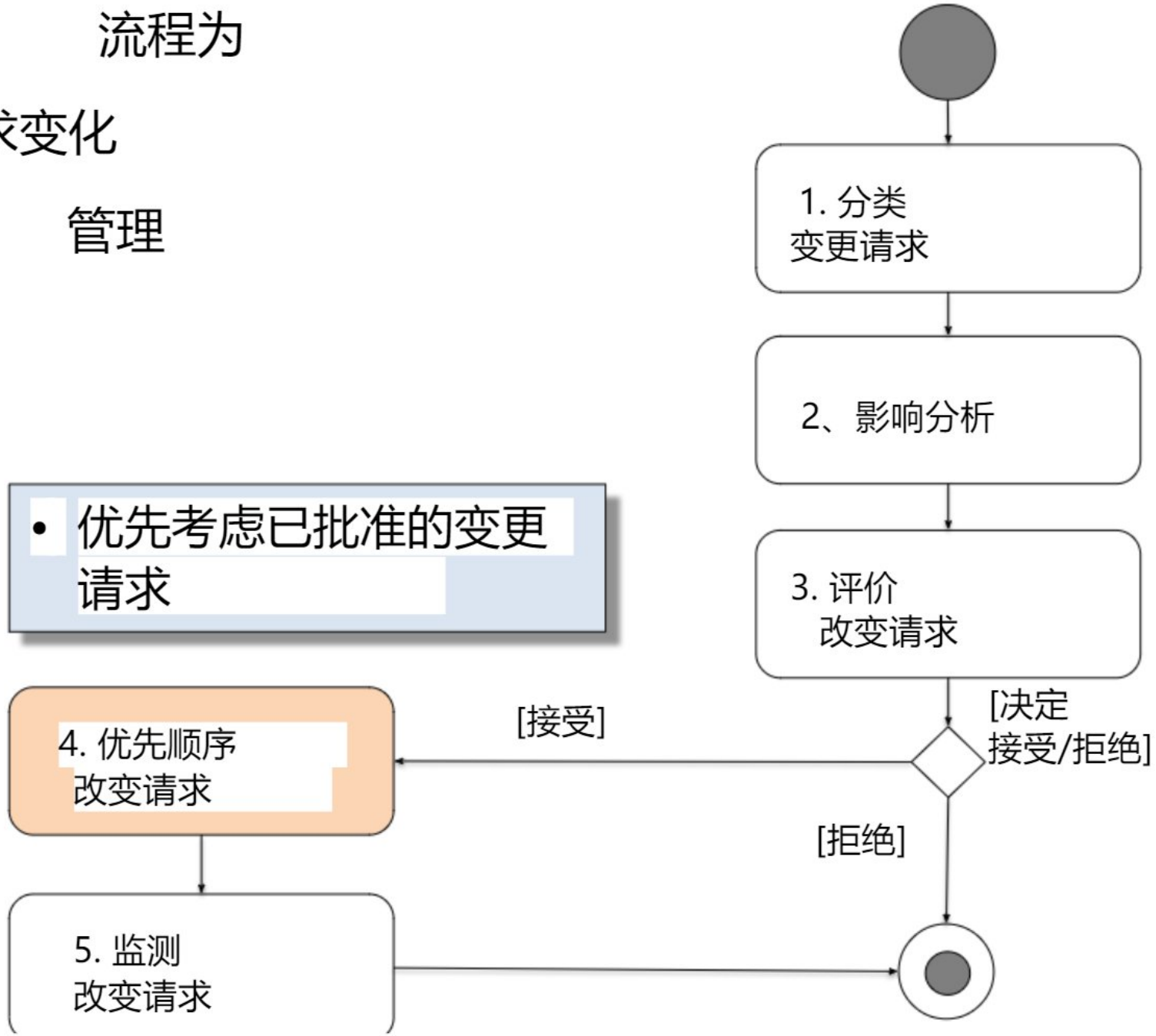


- Prioritise the approved change requests

流程为

需求变化

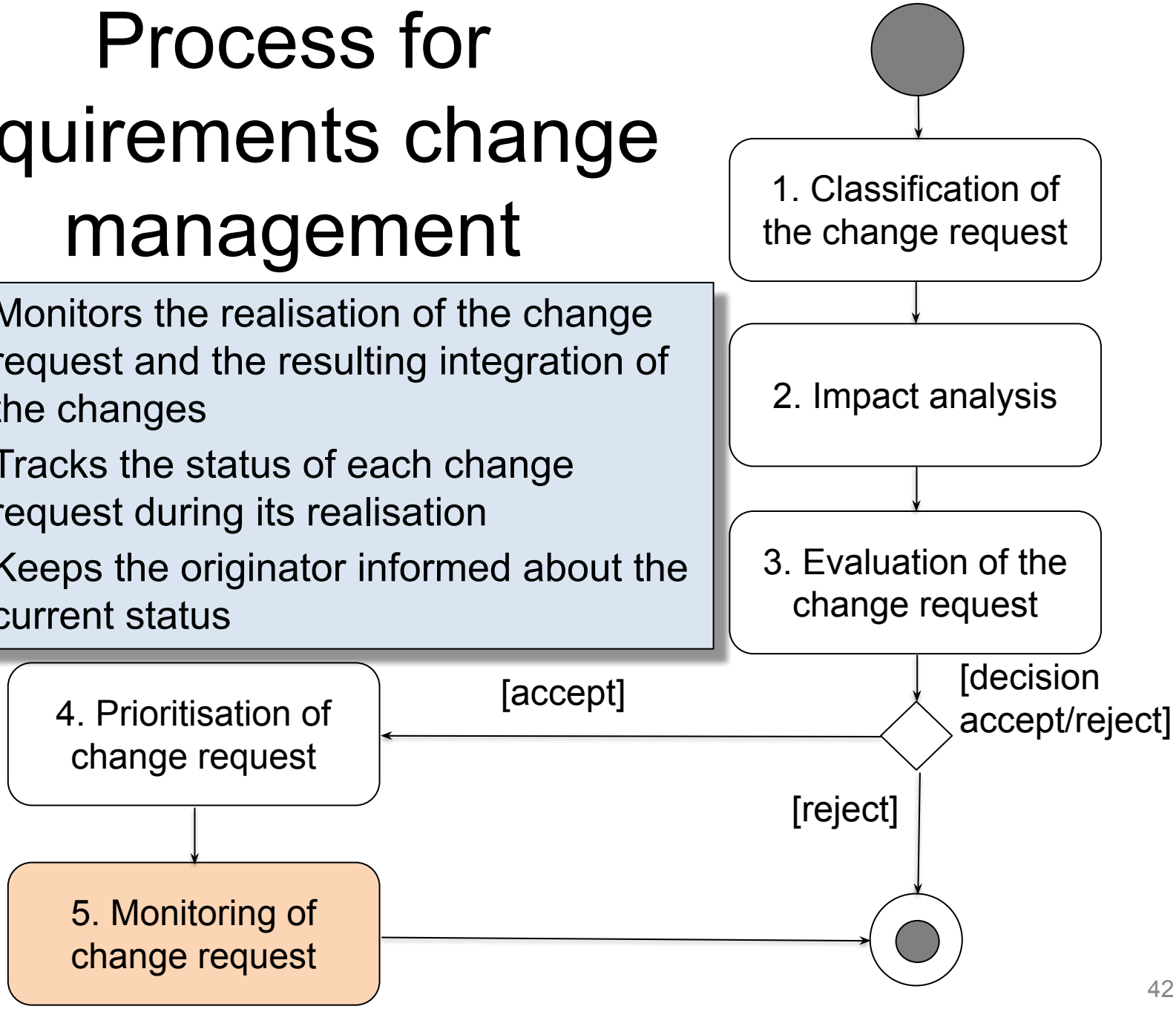
管理



- 优先考虑已批准的变更请求

Process for requirements change management

- Monitors the realisation of the change request and the resulting integration of the changes
- Tracks the status of each change request during its realisation
- Keeps the originator informed about the current status

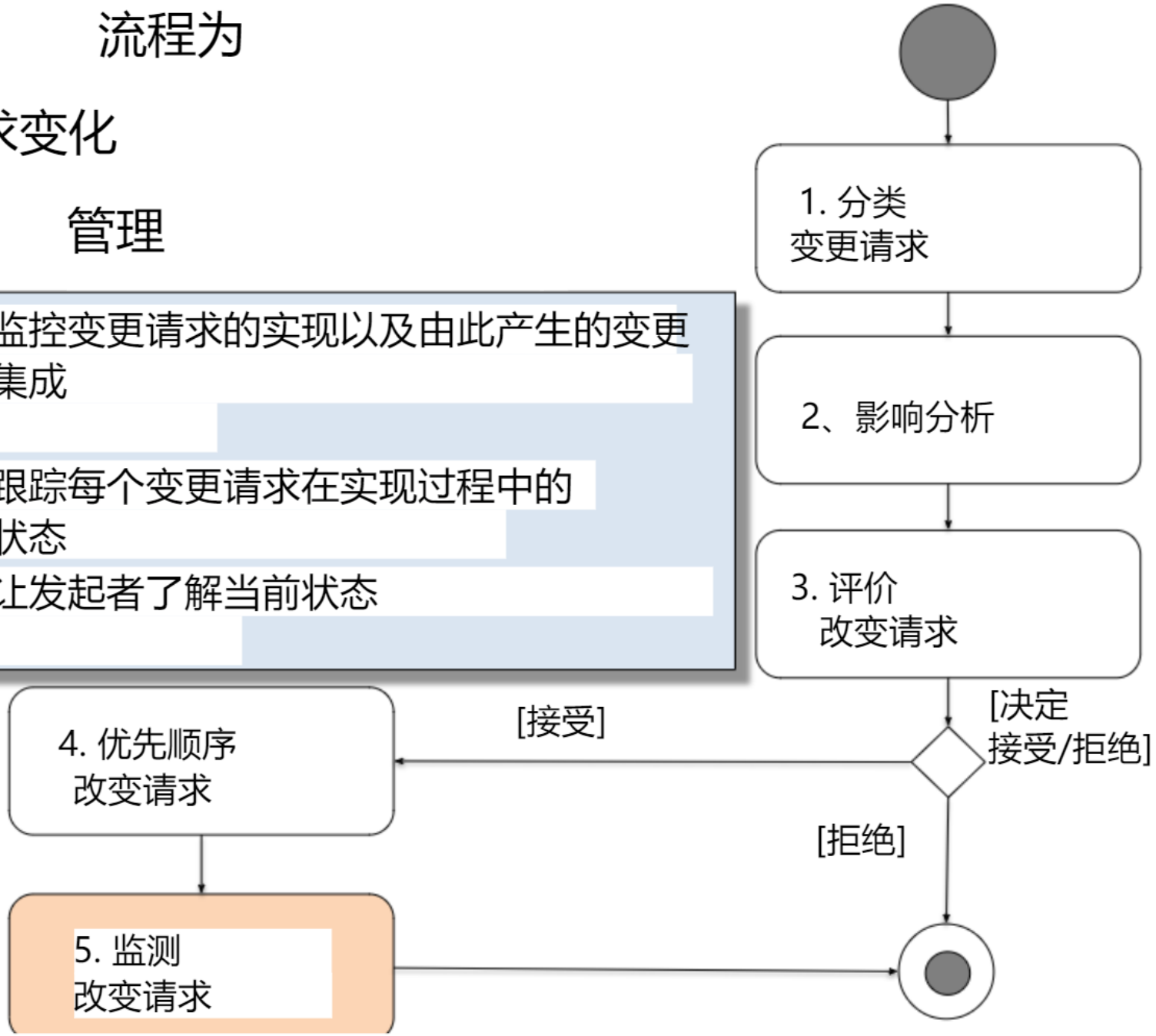


流程为

需求变化

管理

- 监控变更请求的实现以及由此产生的变更集成
- 跟踪每个变更请求在实现过程中的状态
- 让发起者了解当前状态



Things to Take Home

- Configuration management
  - Requirements changes
- Causes for requirements change
- Activities of change management

带回家的东西

- 配置管理
  - 需求变更
- 需求变更的原因
- 变革管理活动