最小责任闭包形式系统
Formal System of Minimal Responsibility Closure

0. 系统目标
0. System Objective

刻画一种责任结构，使责任在系统具备能力时优先内部结算，并约束持续回避内部结算将导致不可控的外部结算。

To formalize a responsibility structure in which internal settlement is prioritized whenever the system has the capacity, and in which persistent avoidance of internal settlement leads to uncontrollable external settlement.

1. 语言（签名）
1. Language (Signature)
1.1 排序（Sorts）
1.1 Sorts

中文	English	符号/symbol
系统	System	S
行为	Action	A
后果	Consequence	C
责任主体	Responsible Agent	R
时间	Time	T

1.2 谓词与函数
1.2 Predicates and Functions

符号/symbol	中文	English
$\mathrm{In}(x, s)$	x 在系统 s 内	x is internal to system s
$\mathrm{Occur}(a, t)$	行为 a 于 t 发生	action a occurs at t
$\mathrm{Cause}(a, c)$	行为导致后果	action causes consequence
$\rho(c) = r$	后果责任归属	responsibility assignment
$\mathrm{Settle}(s, c, t)$	系统结算后果	system settles consequence
$\mathrm{Int}(s, c, t)$	内部结算	internal settlement
$Ext(s, c, t)$	外部结算	external settlement
$\mathrm{Cap}(s, c, t)$	系统具备内部结算能力	internal settlement capacity
$\mathrm{Delay}(s, c, t)$	持续回避内部结算	continued internal settlement avoidance
$\mathrm{UnctlExt}(s, c, t)$	不可控外部结算	uncontrollable external settlement

2. 公理
2. Axioms

A1. 结算互斥
A1. Settlement Exclusivity

$$\forall s, c, t: \ \mathrm{Settle}(s, c, t) \rightarrow \big(\mathrm{Int}(s, c, t) \oplus \mathrm{Ext}(s, c, t)\big)$$

For any settlement, it is either internal or external, but not both.

A2. 内部性
A2. Internality

$$\forall s, c, t: \ \mathrm{Int}(s, c, t) \rightarrow \mathrm{In}(c, s)$$

Internal settlement applies only to consequences internal to the system.

A3. 责任可追溯
A3. Responsibility Traceability

$$\forall c \ \exists! \, r: \ \rho(c) = r$$

Every consequence has exactly one responsible agent.

A4. 内部结算优先
A4. Internal Settlement Priority

$$\forall s, c, t: \ \big(\mathrm{Cap}(s, c, t) \wedge \mathrm{In}(c, s)\big) \rightarrow \neg \mathrm{Ext}(s, c, t)$$

If the system has the capacity to settle internally, external settlement is not permitted.

A5. 延迟定义
A5. Definition of Delay

$$\mathrm{Delay}(s, c, t) \ \leftrightarrow \ \big(\mathrm{Cap}(s, c, t) \ \wedge \ \mathrm{In}(c, s) \ \wedge \ \neg \exists t' \leq t \ \mathrm{Int}(s, c, t')\big)$$

A6. 延迟 ⇒ 不可控外部结算
A6. Delay Implies Uncontrollable External Settlement

$$\big(\forall t \ \exists t' > t: \ \mathrm{Delay}(s, c, t')\big) \ \rightarrow \ \exists t: \ \mathrm{UnctlExt}(s, c, t)$$

If internal settlement is indefinitely delayed, uncontrollable external settlement will eventually occur.

A7. 不可控外部结算是外部结算
A7. Uncontrollable External Settlement Is External

$$\mathrm{UnctlExt}(s, c, t) \rightarrow \mathrm{Ext}(s, c, t)$$

Any uncontrollable external settlement is an external settlement.

3. 定义
3. Definitions
D1. 责任闭包
D1. Responsibility Closure

$$\mathrm{Closed}(s) \stackrel{\text{def}}{=} \forall c \left(\mathrm{In}(c, s) \rightarrow \exists t\, \mathrm{Int}(s, c, t)\right)$$

A system is closed if all internal consequences are eventually settled internally.

D2. 最小责任闭包
D2. Minimal Responsibility Closure

$$\mathrm{MRC}(s) \stackrel{\text{def}}{=} \mathrm{Closed}(s)$$

A system satisfies Minimal Responsibility Closure iff it is responsibility-closed.
(Minimality is implicitly constrained by A4–A6; no additional elements are introduced.)

4. 核心定理
4. Core Theorem
T1. 持续回避内部结算导致系统失控
T1. Persistent Internal Settlement Avoidance Leads to Loss of Control

$$\neg\mathrm{MRC}(s) \leftarrow \exists c:\ \forall t\, \exists t' > t:\ \mathrm{Delay}(s, c, t')$$

If there exists a consequence for which internal settlement is indefinitely delayed, the system fails to satisfy Minimal Responsibility Closure.

5. 排除声明
5. Exclusion Statement

本系统不引入任何终极外部结算者。
任何将责任交由系统外部不可判定实体或超系统机制的做法，均被视为责任闭包的失败态。

No ultimate external settler is introduced in this system.
Any delegation of responsibility to an externally non-decidable entity or supra-system mechanism is treated as a failure mode of responsibility closure.

6. 冻结声明
6. Freeze Declaration

以上符号、公理与定义在重新编号前视为冻结。

All symbols, axioms, and definitions above are considered frozen unless renumbered.

附录 A：多系统耦合与尺度问题
Appendix A: Multi-System Coupling and Scale

A.1 附录目的
A.1 Purpose of This Appendix

本附录用于说明：当最小责任闭包形式系统应用于多系统耦合场景时，责任判据将受到尺度选择的影响。
本附录不修改主系统的公理与定义，仅用于明确其适用边界与失效条件。

This appendix clarifies how the Formal System of Minimal Responsibility Closure behaves under multi-system coupling.
It does not modify the axioms or definitions of the main system, but specifies applicability boundaries and failure conditions arising from scale selection.

A.2 多系统耦合的定义
A.2 Definition of Multi-System Coupling

多系统耦合指至少两个系统
Multi-system coupling refers to situations in which at least two systems

$$s1, s2 \in S$$

在行为、后果或结算路径上发生非平凡相互作用的情形。
在此情形下，“系统内 / 系统外”的判定不再是绝对命题。
interact non-trivially in actions, consequences, or settlement paths.
In such cases, the distinction between “internal” and “external” is no longer absolute.

A.3 尺度作为隐含变量
A.3 Scale as an Implicit Variable

在多系统耦合场景中，以下判断均隐含一个未显式建模的尺度参数：

内部 / 外部
责任归属
结算路径

In multi-system settings, the following judgments implicitly depend on an unmodeled scale parameter:

internal vs. external
responsibility attribution
settlement pathways

形式系统中使用的谓词
The predicate

$$In(x, s)$$

在多系统情形下应被理解为：
should therefore be interpreted as:

$$In(x, s \mid \sigma)$$

其中σ表示观察或判定尺度。
where σ denotes the observation or decision scale.

A.4 尺度漂移与责任判据漂移
A.4 Scale Drift and Responsibility Drift

在不同尺度下，同一结算路径可能被判定为：

在系统 S_1内部

在系统 S_2外部

在复合系统 $S = s_1 \cup s_2$内部

因此，在多系统耦合下，责任闭包判据可能随尺度变化而发生漂移。
该漂移并非逻辑矛盾，而是尺度未冻结所导致的结构现象。

At different scales, the same settlement pathway may be classified as:

internal to system S_1

external to system S_2

internal to the composite system $S = s_1 \cup s_2$

Accordingly, responsibility closure criteria may drift with scale.
This drift is not a logical contradiction, but a structural consequence of unfixed scale.

A.5 主系统的适用边界
A.5 Applicability Boundary of the Main System

最小责任闭包形式系统在以下条件下保持有效：

系统边界在所选尺度上是稳定且明确的

内部结算能力在该尺度上可判定

责任归属不跨越未建模的系统层级

若上述条件不满足，则主系统的结论仅在**所选尺度下**成立。

The Formal System of Minimal Responsibility Closure remains valid under the following conditions:

system boundaries are stable and well-defined at the chosen scale

internal settlement capacity is decidable at that scale

responsibility attribution does not cross unmodeled system layers

If these conditions fail, conclusions of the main system hold **only relative to the selected scale.**

A.6 失效模式（多系统情形）
A.6 Failure Modes in Multi-System Contexts

在多系统耦合场景中，以下情形被视为责任闭包的失效模式：

结算路径在不同尺度下被反复重新分类

内部结算被系统间转移而非完成

责任因尺度切换而持续外包

这些情形通常表现为：
内部结算被结构性延迟，而非被拒绝。

In multi-system coupling, the following are considered failure modes of responsibility closure:

settlement paths are repeatedly reclassified across scales

internal settlement is displaced across systems rather than completed

responsibility is persistently outsourced through scale shifts

Such cases typically manifest as **structural deferral of internal settlement,** not explicit refusal.

A.7 附录结论
A.7 Appendix Conclusion

多系统耦合不会否定最小责任闭包原则，
但会将其从绝对判据转化为**尺度依赖判据**。

因此，在多系统场景中，
任何责任闭包判断都必须同时声明其适用尺度。

Multi-system coupling does not invalidate the principle of Minimal Responsibility Closure,
but transforms it from an absolute criterion into a **scale-dependent criterion**.

Accordingly, any responsibility closure judgment in multi-system contexts must explicitly declare its applicable scale.

附录状态
Appendix Status

本附录不修改主系统，仅用于边界标注与失效条件说明。

This appendix does not modify the main system and serves solely to specify boundaries and failure conditions.

附录 B：尺度冻结与尺度作弊
Appendix B: Scale Freezing and Scale Cheating

B.1 附录目的
B.1 Purpose of This Appendix

本附录用于刻画在责任判定过程中，**尺度未冻结**所引发的结构性风险，并给出尺度作弊的判据。
本附录不规定尺度如何选择，仅用于判断尺度是否被不当使用。

This appendix characterizes the structural risks arising from **unfrozen scales** during responsibility assessment and provides criteria for detecting scale cheating.
It does not prescribe how scales should be chosen; it only assesses whether scales are improperly used.

B.2 尺度冻结的定义
B.2 Definition of Scale Freezing

尺度冻结是指：
在一次责任判定过程中，所采用的尺度 σ 在判定完成前保持不变。

尺度冻结不要求尺度正确，仅要求尺度稳定。

Scale freezing means that, during a responsibility assessment, the selected scale σ remains unchanged until the assessment is concluded.

Scale freezing does not require the scale to be correct—only stable.

B.3 尺度未冻结的结构后果
B.3 Structural Consequences of Unfrozen Scale

当尺度在判定过程中发生变化时，将产生以下结构性后果：

责任归属无法闭合

内部结算持续被延迟

结算路径在系统间漂移

上述后果并非逻辑错误，而是判定条件不稳定所导致的结构失效。

When scale shifts during assessment, the following structural consequences arise:

responsibility attribution cannot close

internal settlement is persistently deferred

settlement paths drift across systems

These outcomes are not logical errors, but structural failures caused by unstable assessment conditions.

B.4 尺度作弊的定义
B.4 Definition of Scale Cheating

尺度作弊是指：
在责任判定过程中，通过切换尺度 σ，使原本应在某一尺度下完成的内部结算，被转移或延迟至其他尺度。

尺度作弊不依赖否认责任，而依赖尺度重分类。

Scale cheating refers to the practice of shifting scales σ during responsibility assessment, such that internal settlement required at one scale is displaced or deferred to another.

Scale cheating does not rely on denying responsibility, but on reclassifying scale.

B.5 尺度作弊的判据
B.5 Criteria for Scale Cheating

若在一次责任判定中出现以下任一情形，则可判定存在尺度作弊：

同一结算路径在不同尺度下被反复重新分类

内部结算能力在尺度切换后被重新否认

责任主体因尺度变化而持续外包

Scale cheating is identified if any of the following occur during a responsibility assessment:

the same settlement path is repeatedly reclassified across scales

internal settlement capacity is re-denied after scale shifts

responsibility is persistently outsourced through scale changes

B.6 与最小责任闭包的关系
B.6 Relation to Minimal Responsibility Closure

尺度作弊不会立即否定最小责任闭包原则，
但会使其判据在实际判定中失效。

因此，任何基于最小责任闭包的判断，
均隐含一个前提：尺度在判定期间被冻结。

Scale cheating does not immediately invalidate the principle of Minimal Responsibility Closure, but renders its criteria inoperative in practice.

Accordingly, any judgment based on Minimal Responsibility Closure implicitly assumes that the scale is frozen during assessment.

B.7 附录结论
B.7 Appendix Conclusion

多系统复杂性并非责任失效的唯一来源。
尺度未冻结本身即可构成责任闭包失败的充分条件。

因此，尺度冻结不是附加约束，
而是责任判定成立的前提条件。

Multi-system complexity is not the sole source of responsibility failure.
Unfrozen scale alone is sufficient to cause failure of responsibility closure.

Thus, scale freezing is not an additional constraint,
but a prerequisite for valid responsibility assessment.

附录状态
Appendix Status

本附录不扩展主系统，仅用于尺度相关失效模式的识别。

This appendix does not extend the main system and serves solely to identify scale-related failure modes.

附录 C：责任判定的最小输入可接受条件
Appendix C: Minimal Input Acceptability Conditions for Responsibility Assessment
C.1 附录目的
C.1 Purpose of This Appendix

本附录用于规定：
在使用最小责任闭包（MRC）进行责任判定之前，**哪些输入条件是不可接受的**。
本附录不定义责任、不定义结算、不定义能力，**仅用于拒绝无效或作弊性输入**。

This appendix specifies which inputs are inadmissible prior to applying Minimal Responsibility Closure (MRC).
It does not define responsibility, settlement, or capacity; it solely rejects invalid or cheating inputs.

C.2 输入可接受性的原则
C.2 Principle of Input Acceptability

若某一输入在结构上使责任判定不可能闭合，
则该输入在进入 MRC 判定之前即应被拒绝。

If an input structurally prevents responsibility from closing,
it must be rejected before entering MRC assessment.

C.3 不可接受的尺度输入

C.3 Inadmissible Scale Inputs
C3.1 荒谬尺度拒绝
C3.1 Rejection of Absurd Scales

若所声明的尺度 σ 使得任何合理后果均被系统性排除在责任判定之外，
则该尺度输入不可接受。

If a declared scale σ systematically excludes all reasonable consequences from responsibility assessment,
the scale input is inadmissible.

C3.2 退化尺度拒绝
C3.2 Rejection of Degenerate Scales

若尺度被定义为仅覆盖单一不可独立结算的最小单元，
且该单元无法完成任何非平凡内部结算，
则该尺度输入不可接受。

If a scale is defined to cover only a minimal unit incapable of independent non-trivial internal settlement,
the scale input is inadmissible.

C.4 不可接受的系统边界声明
C.4 Inadmissible System Boundary Declarations

若系统边界由系统自身单方面声明，
且该声明直接导致内部结算能力的系统性否认，
则该系统边界输入不可接受。

If system boundaries are unilaterally declared by the system itself
and such declaration systematically denies internal settlement capacity,
the boundary input is inadmissible.

C.5 不可接受的能力否认（Cap）
C.5 Inadmissible Capacity Denial (Cap)

若系统声称不存在内部结算能力，
但未提供任何可外部核查的结构性理由，
则该能力否认输入不可接受。

If a system denies internal settlement capacity
without providing any externally verifiable structural justification,
the capacity denial input is inadmissible.

C.6 不可接受的内部结算声明（Int）
C.6 Inadmissible Internal Settlement Claims (Int)

若所谓“内部结算”仅表现为象征性、叙事性或不可验证的行动，
且不改变后果状态或责任结构，
则该内部结算声明不可接受。

English
If an alleged “internal settlement” is purely symbolic, narrative, or unverifiable
and does not alter consequence states or responsibility structure,
the internal settlement claim is inadmissible.

C.7 不可接受的时间输入
C.7 Inadmissible Temporal Inputs

若判定过程的开始与结束时间被反复重定义，
以规避延迟（Delay）判据的触发，
则该时间输入不可接受。

If the start or end of an assessment process is repeatedly redefined
to evade Delay criteria,
the temporal input is inadmissible.

C.8 输入拒绝的效果
C.8 Effect of Input Rejection

任何被判定为不可接受的输入，
不得进入最小责任闭包判定流程。

输入拒绝不等价于责任判定结果，
而是判定前的结构性拦截。

Any inadmissible input
must not enter the Minimal Responsibility Closure assessment process.

Input rejection is not a responsibility judgment;
it is a structural precondition check.

C.9 附录结论
C.9 Appendix Conclusion

最小责任闭包不要求输入真实、善意或完整，
但要求输入不破坏责任闭合的可能性。

因此，输入可接受性不是道德判断，
而是结构判定的必要前提。

Minimal Responsibility Closure does not require inputs to be truthful, benevolent, or complete,
but requires that inputs do not destroy the possibility of responsibility closure.

Input acceptability is therefore not a moral judgment,
but a necessary structural precondition.

附录状态
Appendix Status

本附录不扩展主系统，仅用于拒绝破坏责任闭包的输入条件。

This appendix does not extend the main system and serves solely to reject inputs that undermine responsibility closure.

附录 D：违规输出与外部执行接口
Appendix D: Violation Output and External Enforcement Interface

D.1 附录目的
D.1 Purpose of This Appendix

本附录用于规定：
当最小责任闭包（MRC）在判定过程中识别出结构性违规或失效模式时，
如何以最小、可复用的形式输出结果，以供外部执行系统使用。

本附录不定义任何惩罚、补救或治理措施，
仅定义**判定结果的输出接口**。

This appendix specifies how, when Minimal Responsibility Closure (MRC) identifies structural violations or failure modes,
the results are output in a minimal and reusable form for external enforcement systems.

This appendix defines no penalties, remedies, or governance actions;
it defines only the **output interface** of responsibility assessment.

D.2 输出接口的基本原则
D.2 Principles of the Output Interface

MRC 只负责判定，不负责执行

输出必须结构化、最小化、去叙事

输出不得隐含任何价值判断或强制建议

外部系统可自由选择是否、如何响应输出

MRC performs assessment only, not enforcement

Outputs must be structured, minimal, and non-narrative

Outputs must not imply value judgments or enforcement recommendations

External systems may freely decide whether and how to respond

D.3 违规输出的定义
D.3 Definition of Violation Output

当满足以下任一条件时，MRC 生成违规输出（Violation Output）：

责任闭包判据未能成立

尺度作弊被检测

输入可接受性条件被触发

内部结算被结构性延迟

违规输出不等价于责任裁决，
仅表示**责任闭合失败或被规避**。

A Violation Output is generated when any of the following occur:

responsibility closure criteria fail

scale cheating is detected

input acceptability conditions are violated

internal settlement is structurally deferred

A violation output is not a responsibility verdict;
it indicates that responsibility closure has failed or been circumvented.

D.4 违规输出的最小结构
D.4 Minimal Structure of Violation Output

中文
每一条违规输出应至少包含以下字段：

Object：被判定的系统或系统集合

Type：违规类型（枚举）

Scale：适用尺度（如已声明）

Time：判定时间或时间区间

Reference：触发的公理 / 附录条款编号

违规输出不得包含结论性责任分配。

Each violation output shall include at minimum:

Object: the assessed system or system set

Type: violation type (enumerated)

Scale: applicable scale, if declared

Time: assessment time or interval

Reference: triggering axiom or appendix clause

Violation outputs must not include definitive responsibility attribution.

D.5 违规类型枚举（非穷尽）
D.5 Violation Type Enumeration (Non-exhaustive)

V-INT：内部结算无效或不可接受

V-CAP：能力否认不可接受

V-SCALE：尺度作弊或尺度未冻结

V-INPUT：输入可接受性违规

V-DELAY：结构性延迟

V-CLOSURE：责任闭包未成立

V-INT: invalid or inadmissible internal settlement

V-CAP: inadmissible denial of capacity

V-SCALE: scale cheating or unfrozen scale

V-INPUT: input acceptability violation

V-DELAY: structural delay

V-CLOSURE: responsibility closure failure

D.6 与外部系统的关系
D.6 Relation to External Systems

违规输出可被外部系统用于：

触发调查

启动审计

激活监管、法律或合约机制

记录为结构性风险信号

MRC 不对外部系统的响应方式承担责任。

Violation outputs may be used by external systems to:

trigger investigations

initiate audits

activate regulatory, legal, or contractual mechanisms

record structural risk signals

MRC assumes no responsibility for external system responses.

D.7 输出的不可逆性与最小性
D.7 Irreversibility and Minimality of Output

违规输出一经生成，即构成一次结构性记录。
其存在不因后续补救行动而自动撤销。

补救行为可生成新的判定，
但不得抹除既有违规输出。

Once generated, a violation output constitutes a structural record.
Its existence is not automatically revoked by subsequent remedial actions.

Remedial actions may trigger new assessments
but must not erase prior violation outputs.

D.8 附录结论
D.8 Appendix Conclusion

最小责任闭包不执行责任，
但拒绝让责任失败悄无声息。

违规输出不是惩罚，
而是责任闭包失败的可传递信号。

Minimal Responsibility Closure does not enforce responsibility,
but refuses to let responsibility failure remain silent.

Violation output is not punishment,
but a transmittable signal of responsibility closure failure.

附录状态
Appendix Status

中文本附录不扩展主系统，仅定义违规判定的输出接口。

This appendix does not extend the main system and defines only the output interface of violation assessment.

灰区声明
Gray Zone Declaration

灰区将始终存在。
本框架不否认灰区的必要性，但拒绝将其纳入责任判定系统内部。
灰区属于协商与博弈层，而非责任闭包层。
任何利用灰区以延迟、转移或外包责任的行为，均应被识别并标记为风险。

Gray zones will always exist.
This framework does not deny their necessity, but refuses to incorporate them into the responsibility assessment system.
Gray zones belong to the layer of negotiation and strategic interaction, not to responsibility closure.
Any use of gray zones to delay, shift, or outsource responsibility shall be identified and flagged as risk.