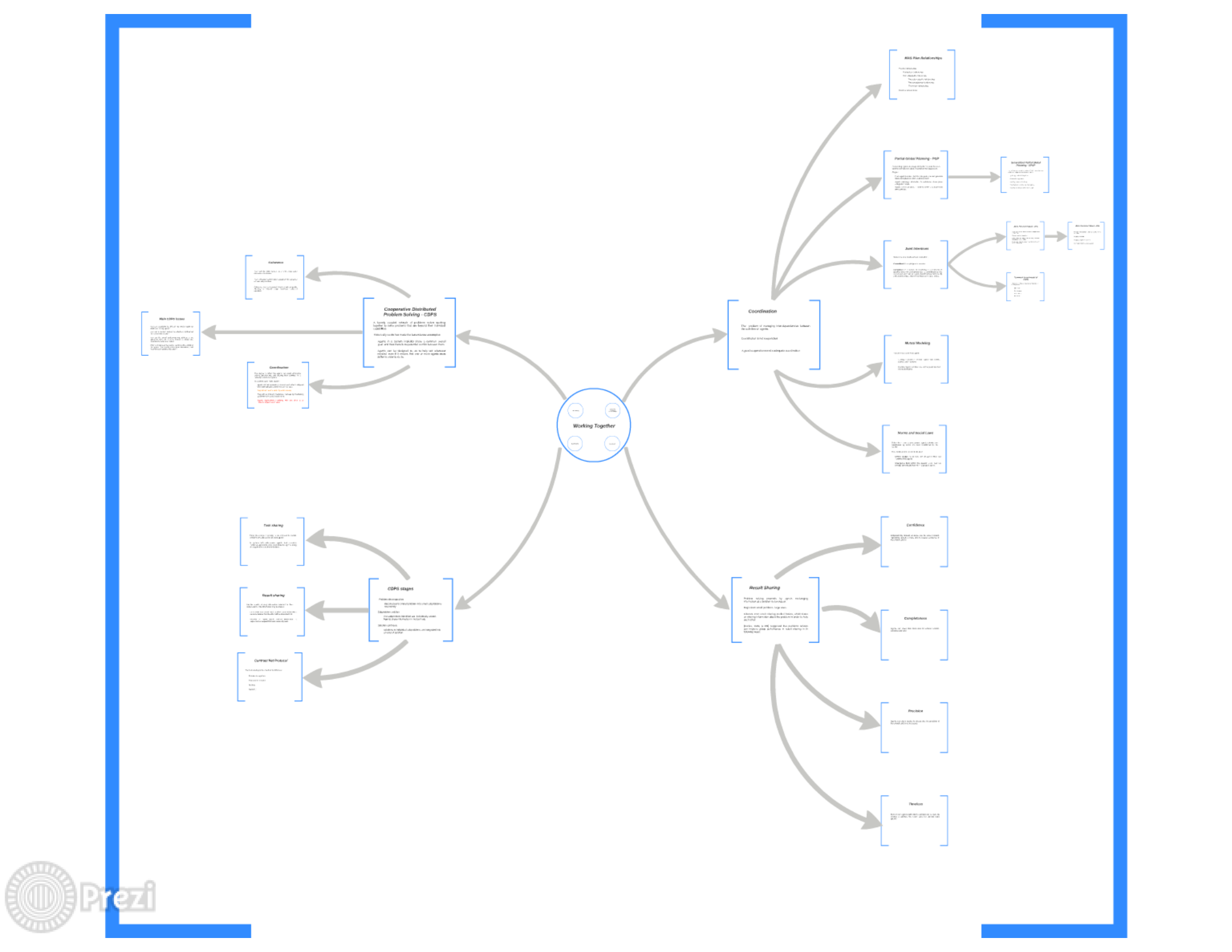
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Mutual Modeling
Norms and Social Laws
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CDPS stages
Result Sharing
Task Sharing
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Completeness
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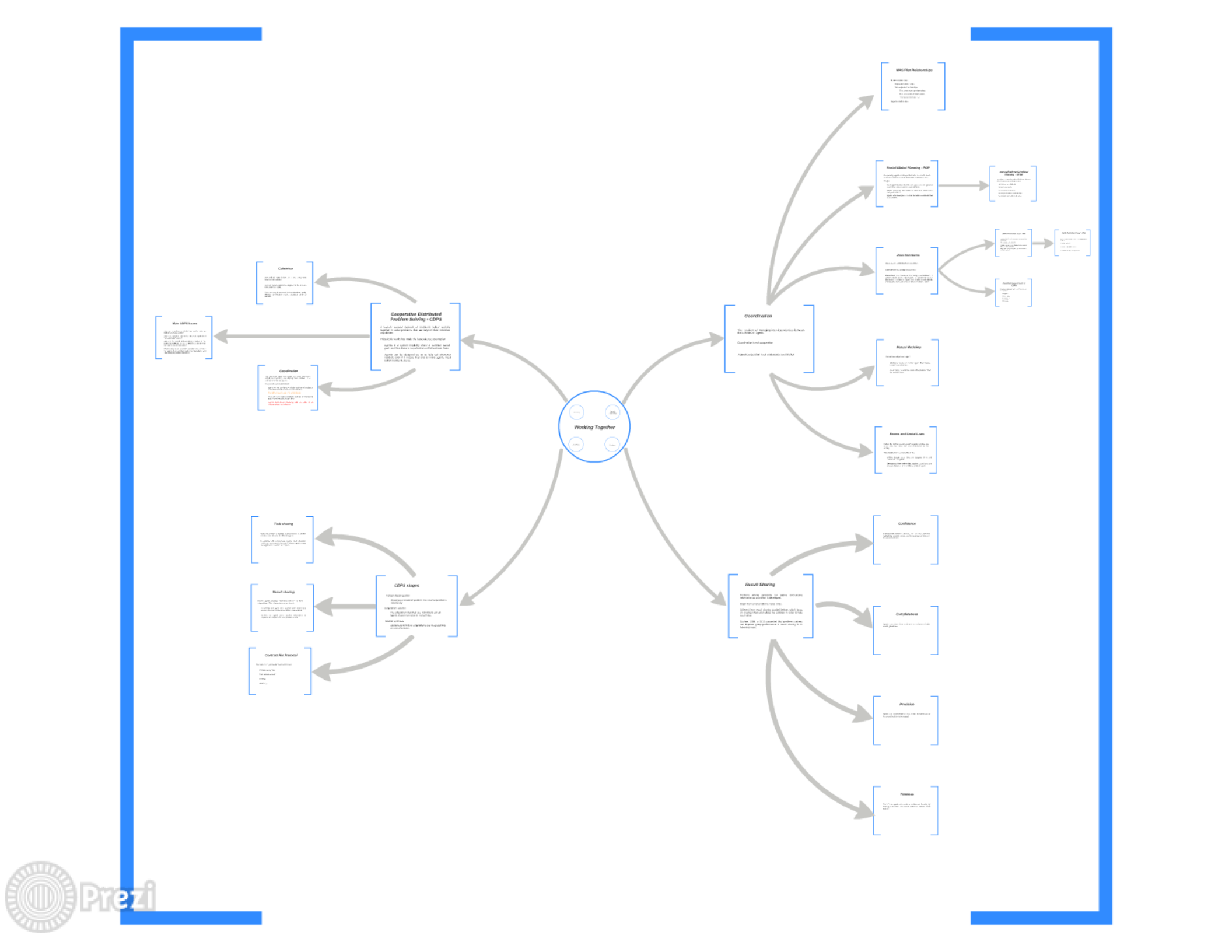
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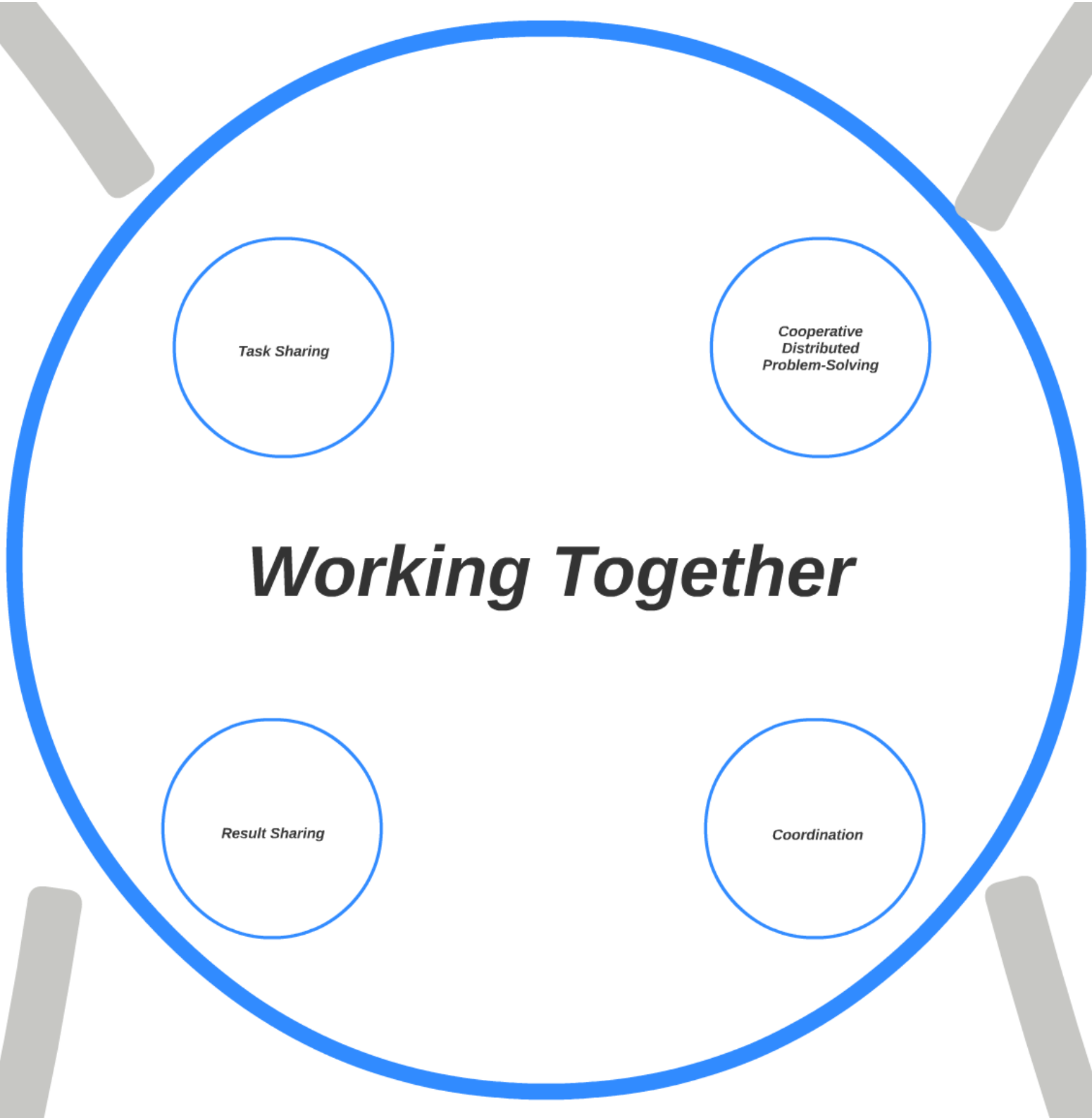
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Cooperative Distributed Problem-Solving

Task Sharing

Result Sharing

Coordination

Cooperative Distributed Problem Solving - CDPS

A loosely coupled network of problems solver working together to solve problems that are beyond their individual capabilities

Historically works has made the benevolence assumption

Agents in a system implicitly share a common overall goal, and thus there is no potential conflict between them.

Agents can be designed so as to help out whenever needed, even if it means that one or more agents must suffer in order to do so.

Coherence

How well the MAS behave as a unit, along some dimension of evaluation

How well system performance degrades in the presence of uncertainty or failure.

Coherence may be measured in term of solution quality, efficiency of resource usage, conceptual clarity of operation

Coordination

The degree to which the agents can avoid extraneous activity synchronizing and aligning their activities. In a perfectly coordinated system

In a perfect coordinated system:

agents will not accidentally clobber each other's subgoals while attempting to achieve the common goal;

they will not need to explicitly communicate;

They will be mutually predictable, perhaps by maintaining good internal models of each other.

Agents destructively interfering with one other is an indicator of poor coordination.

Main CDPS Issues

How can a problem be divided into smaller tasks for distribution among agents?

How can a problem solution be effectively synthesized from subproblem results?

How can the overall problem-solving activities of the agents be optimized so as to produce a solution that maximize the coherence metric?

What techniques can be used to coordinate the activitiy of the agents, thus avoiding destructive interactions, and maximizing any positive interaction?

CDPS stages

Problem decomposition

decompose te overall problem into small subproblems recursively

Subproblem solution

The subproblem identified are individually solved. Agents share information in mutual help.

Solution synthesis

solutions to individual subproblems are integrated into an overall solution.

Task sharing

Takes place when a problem is decomposed to smaller problems and allocated to different agents

In systems with autonomous agents, task allocation involve an agreement to be reach between agents, using the negotiation or auction techniques

Result sharing

Involve agents sharing information relevant to their subproblems. This information may be shared:

proactively: one agent send another some information because believe that the other will be interested in ti.

reactive: an agent sends another information in response to a request that was previously sent.

Contract Net Protocol

The task sharing in the Contract Net Protocol:

- Problem recognition
- Task announcement
- Bidding
- Awarding

Result Sharing

Problem solving proceeds by agents exchanging information as a solution is developed.

Begin from small problems large ones.

Different from result sharing studied before, which focus on sharing information about the problem in order to help each other.

[Durfee, 1999, p 131] suggested that problems solvers can improve group performance in result sharing in th following ways:

Confidence

Independently derived solutions can be cross-checked, highlighting possible errors, and increasing confidence in the overall solution

Completeness

Agents can share their local view to achieve a better overall global view

Precision

Agents can share results to ensure that the precision of the overall solution is increased.

Timeless

Even if one agent could solve a problem on its own, by sharing a solution, the result could be derived more quickly.

Coordination

The problem of managing inter-dependencies between the activities of agents.

Coordination is not cooperation

A good cooperation need a adequate coordination

MAS Plan Relationships

- Positive relationships
  - Requested relationships
  - Non requested relationships
    - The action equality relationships
    - The consequence relationships
    - The favour relationships
- Negative relationships

Partial Global Planning - PGP

Cooperating agents exchange information in order to reach common conclusions about the problem-solving process

Stages:

- Each agent decides what its own goals are and generate short-terms plans in order to achieve them.
- Agents exchange information to determine where plans and goals interact.
- Agents alter local plans in order to better coordinate their own activities.

Generalized Partial Global Planning - GPGP

Is a refined and extended version of PGP that makes use of five techniques to coordinate activities

- Updating new local viewpoints
- Communicating results
- Handling simple redundancy
- Handling hard coordination relationships
- Handling soft coordination relationships

Joint Intentions

Makes use of commitment and convention.

Commitment: is a pledge or a promise

Convention: is a means of monitoring a commitment. It specifies under what circumstances a commitment can be abandoned and how an agent should behave both locally and towards others when one of these conditions arises.

Joint Persistent Goal - JPG

A group of agent has the commitment to bringing about some goal g.

The motivation for this goal is *m*.

Initially, every agent does not believe that g is satisfied, but believe that *g* is possible.

Every agent i then has a goal of *g* until the termination condition is satisfied.

Joint Persistent Goal - JPG

The termination condition is that it is mutually believed that either:

the goal g is satisfied

the goal g is impossible to achieve

the motivation m for g is no longer present

Teamwork based-model of CDPS

A teamwork coordination model for CDPS involve four following stages:

Recognition

Team formation

Plan formation

Team action

Mutual Modeling

Consist basically of each agent:

building a model of another agent: their beliefs, desires, and intentions.

Coordinating its activities around the prediction that this model makes.

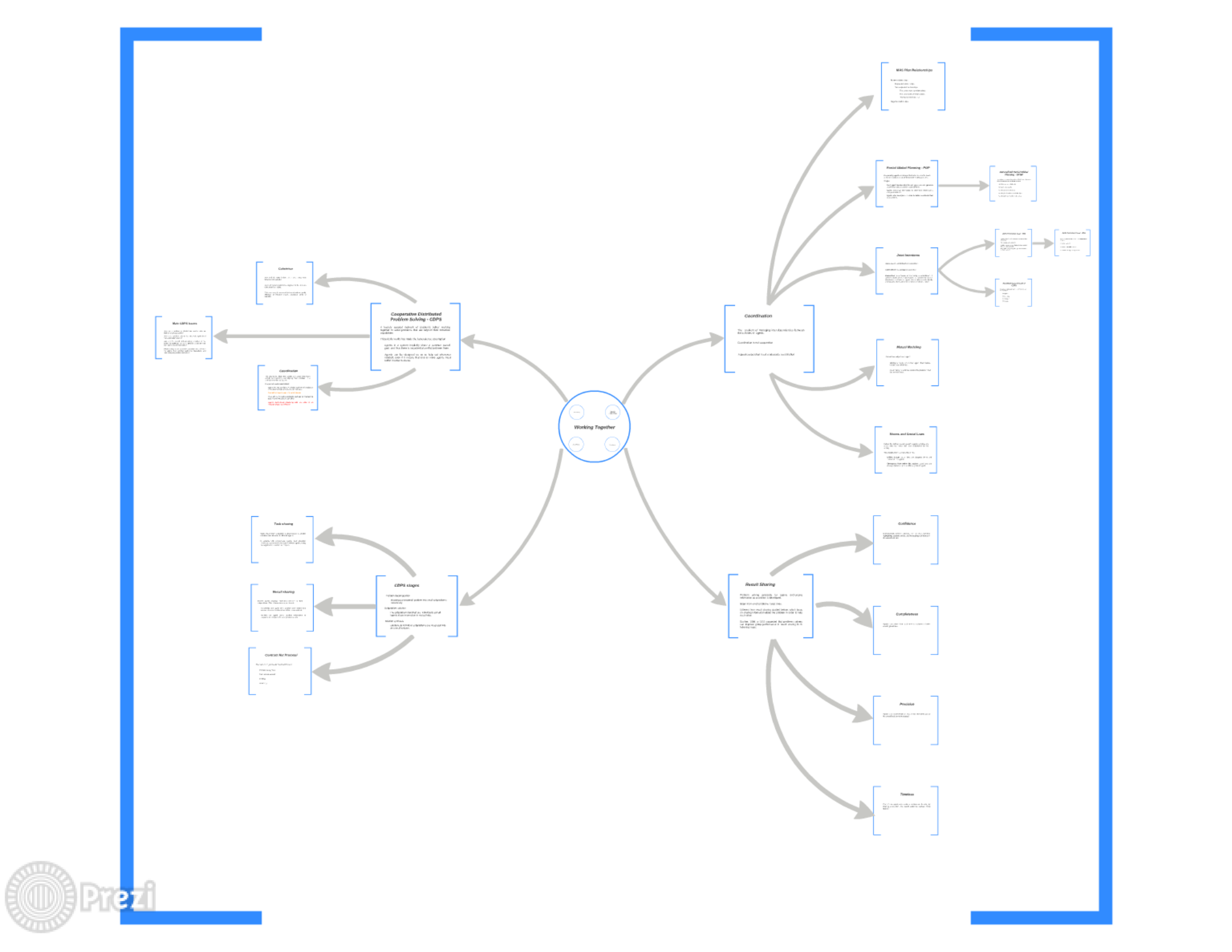
Norms and Social Laws

Follow the human society system: agents activities are coordinated by norms and laws established by the society

This establishment can be of two kinds:

Offline design: social laws are designed offline and hardwired into agents.

Emergence from within the system: social laws are emerge dynamically from within a group of agent .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