

Walking in Tokyo Station - Why is it safe? -

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Profile

Hideki Nomoto
Japan Manned Space Systems

- Manager, Software IV&V
 - 1996-2017 IV&V for Japanese spacecraft (Space Station, Rockets, Satellites and Ground Systems)
 - 2008-2017 Rendezvous Flight Controller for ISS
 - 2013 Applied Resilience Engineering to Japanese next generation ISS transfer vehicle (HTV-X) design as “Resilience Redundancy”
 - 2014-2017 Collaborative Research with Prof. Hollnagel for self-driving car safety
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Objectives

FRAM analysis for
flexible, intelligent and chaotic system

Objectives

How people walk safely in chaotic
Tokyo Station?

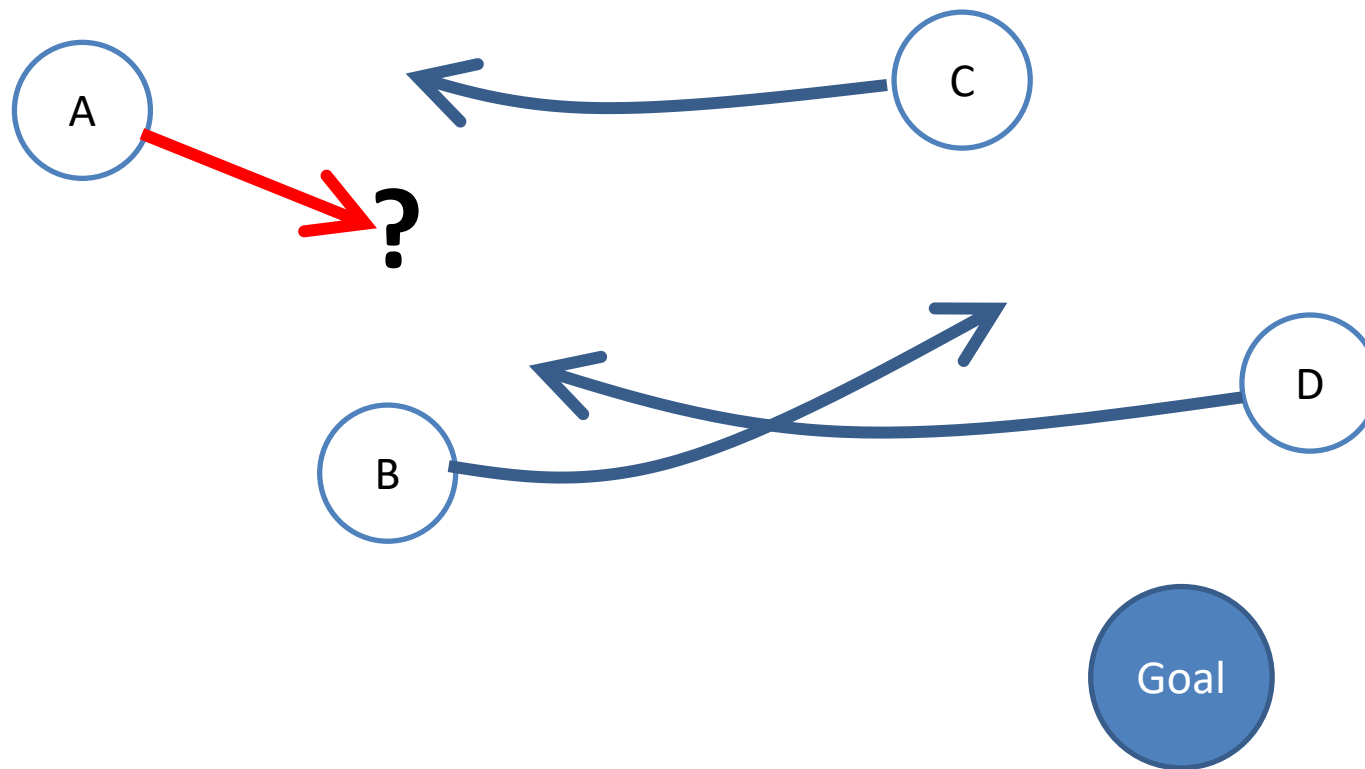
How to Succeed in Tokyo St.?

Concourse in Tokyo Station

- No Fixed Rules
- No Fixed Safe Paths
- No Fixed Actors

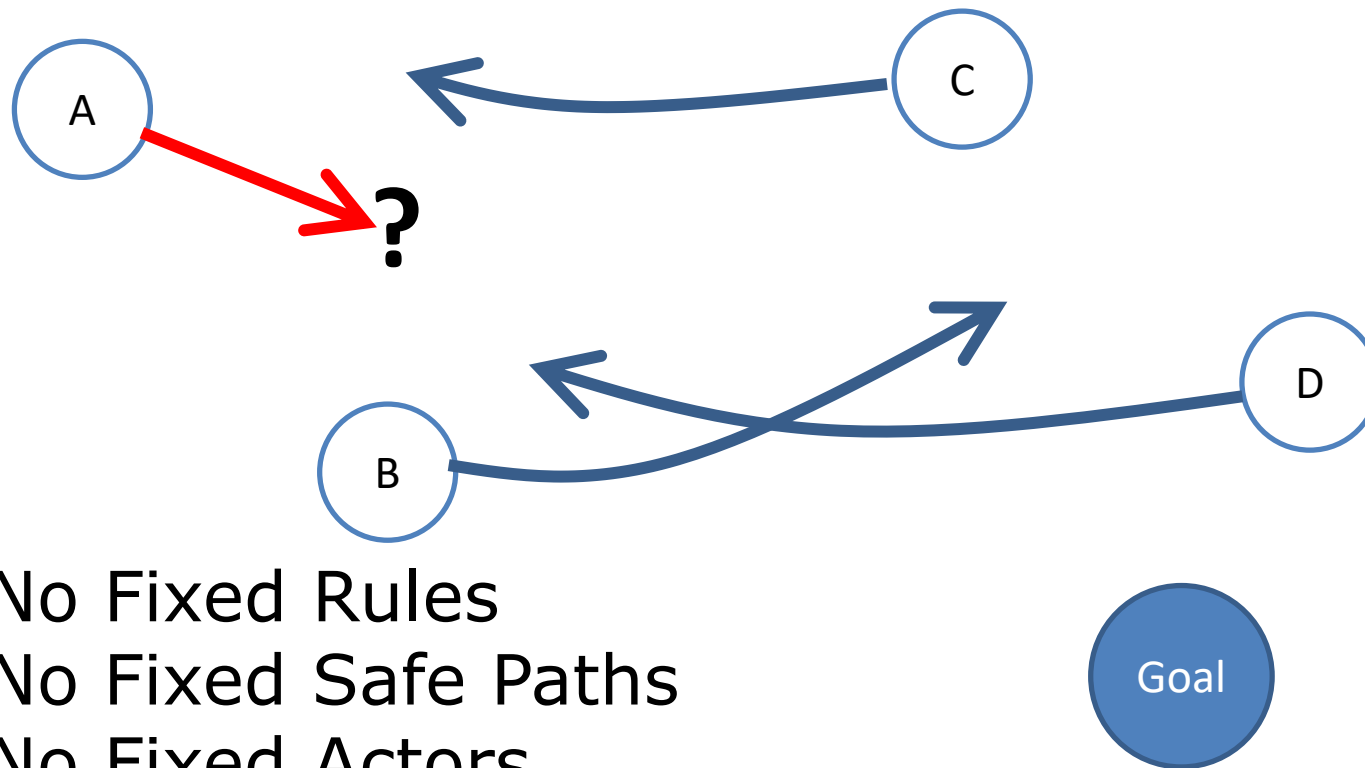


How to Succeed in Tokyo St.?



How to Succeed in Tokyo St.?

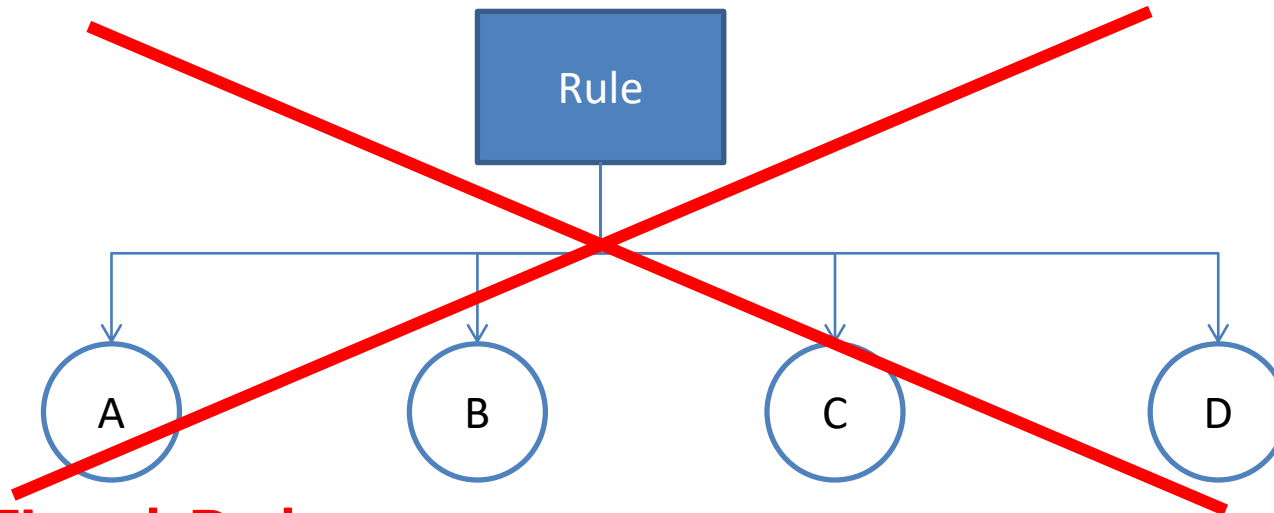
How you can succeed?



- No Fixed Rules
- No Fixed Safe Paths
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How to Succeed in Tokyo St.?

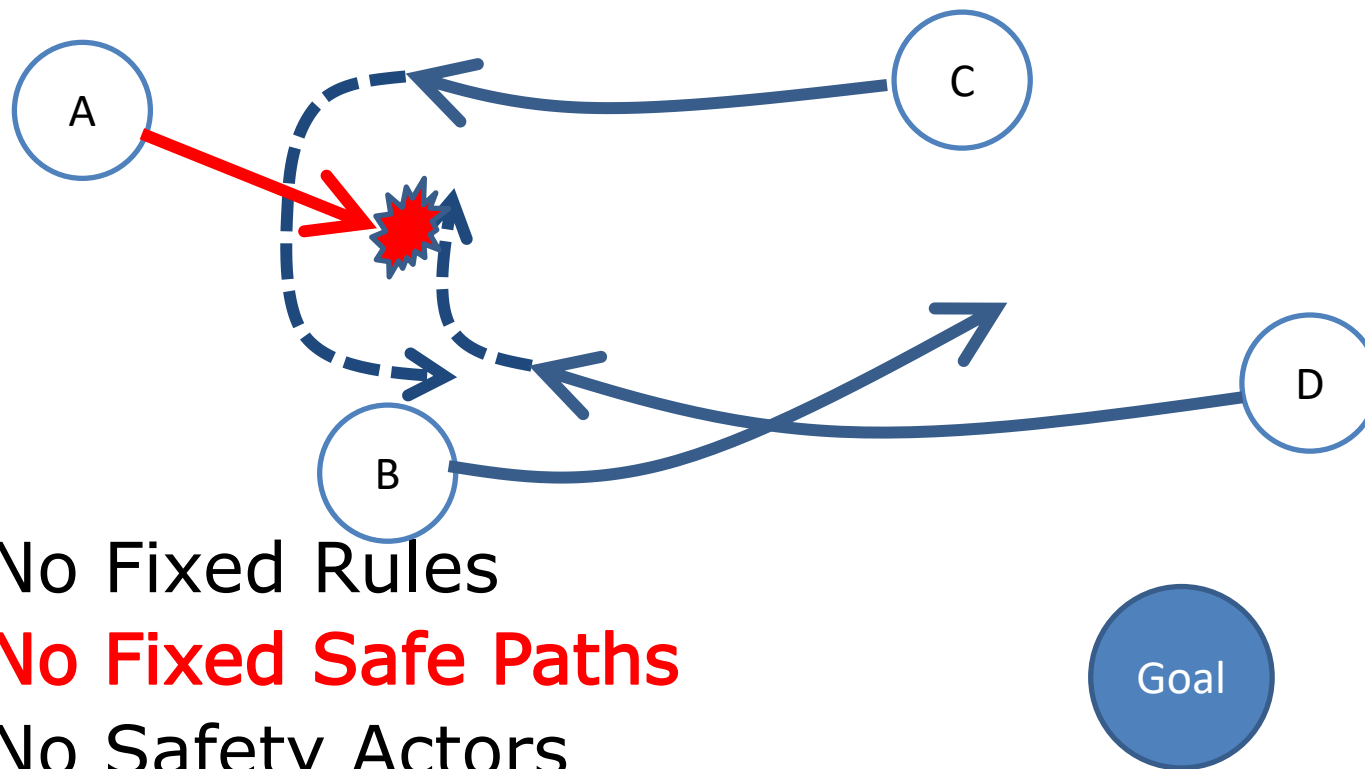
How you can succeed?



- **No Fixed Rules**
- No Fixed Safe Paths
- No Safety Actors

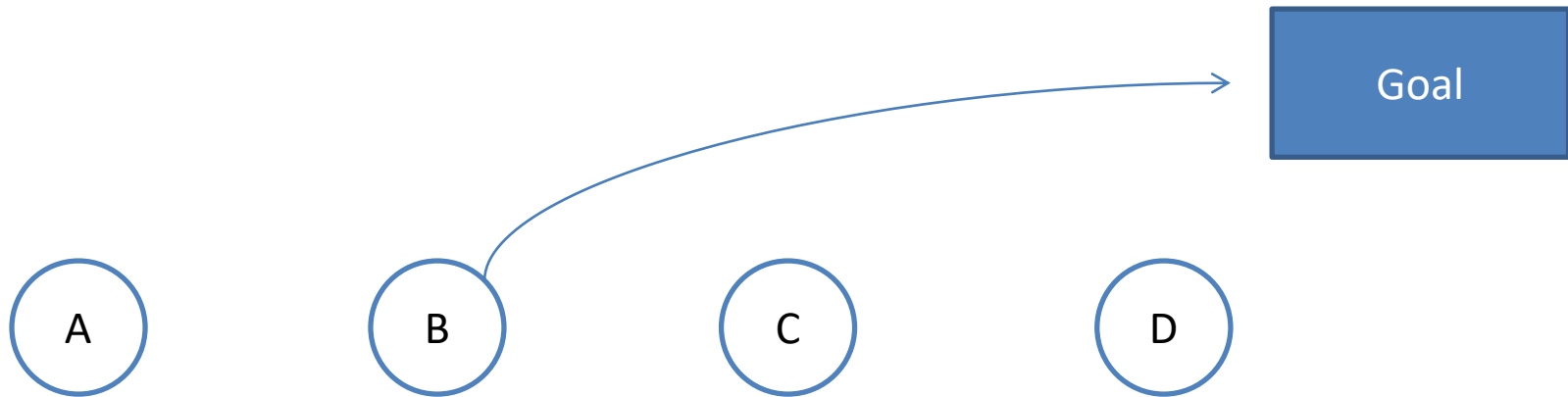
How to Succeed in Tokyo St.?

How you can succeed?



How to Succeed in Tokyo St.?

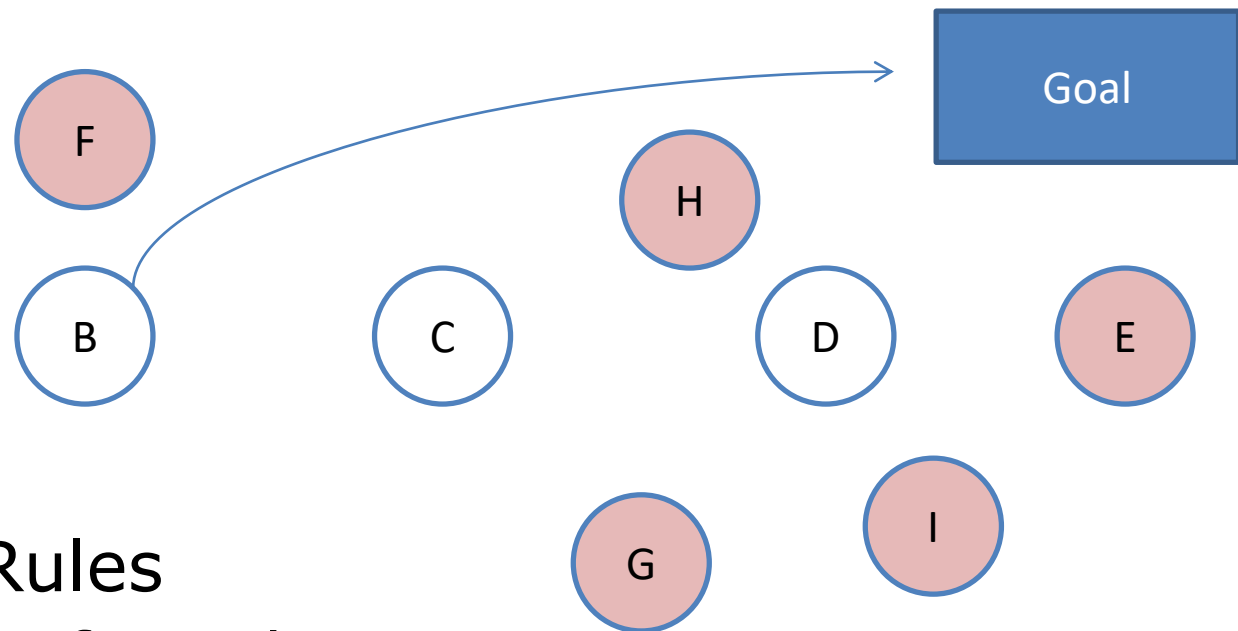
How you can reach to the goal?



- No Fixed Rules
- No Fixed Safe Paths
- **No Fixed Actors**

How to Succeed in Tokyo St.?

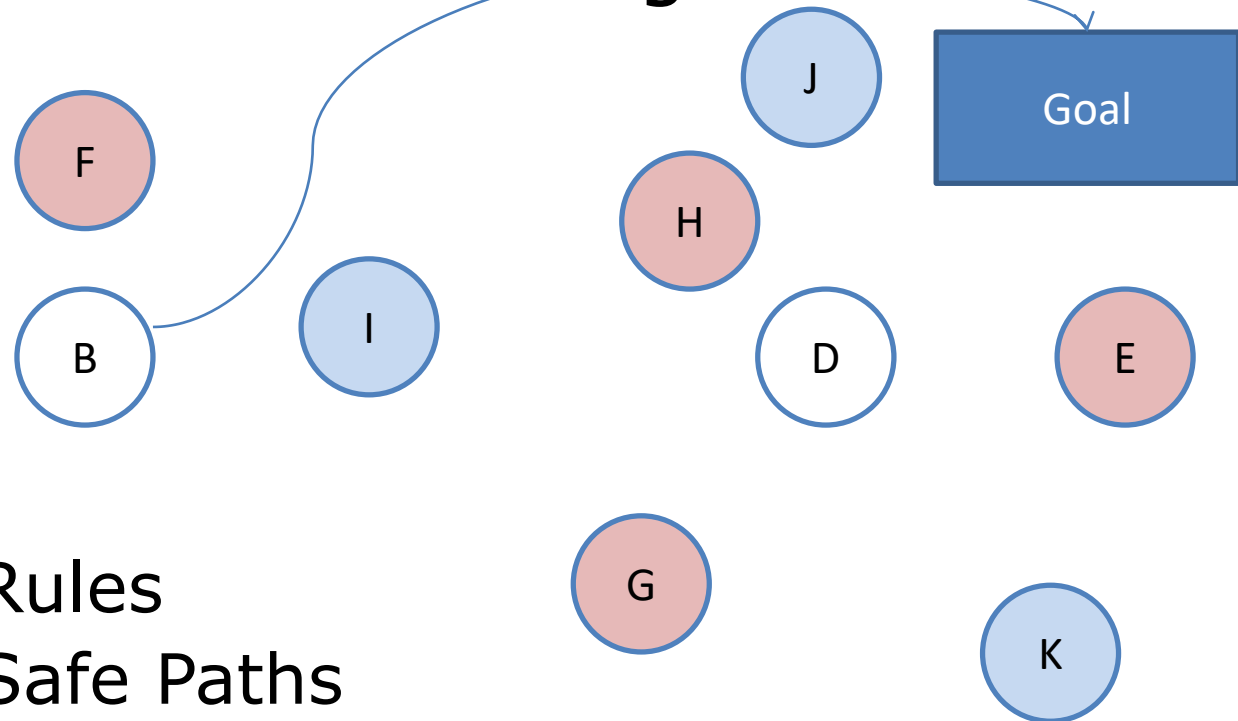
How you can reach to the goal?



- No Fixed Rules
- No Fixed Safe Paths
- **No Fixed Actors**

How to Survive in Tokyo St

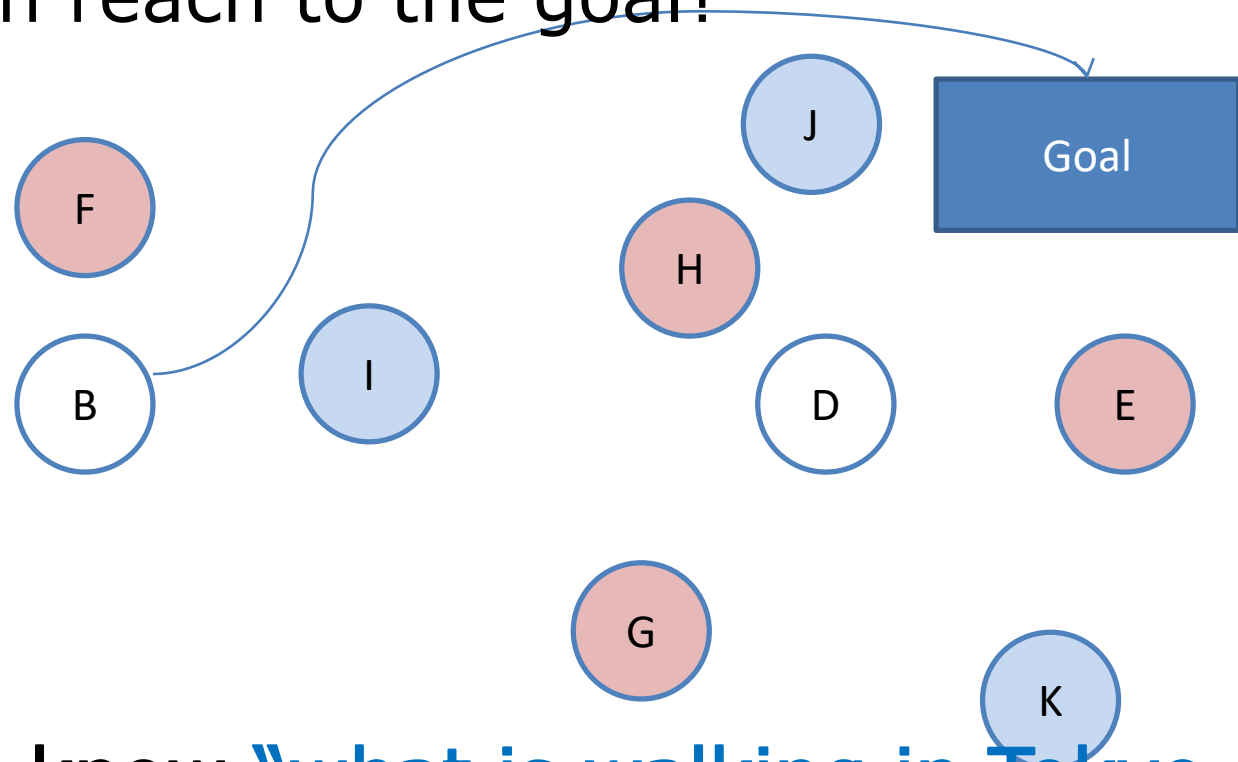
How you can reach to the goal?



- No Fixed Rules
- No Fixed Safe Paths
- **No Fixed Actors**

How to Succeed in Tokyo St.?

How you can reach to the goal?

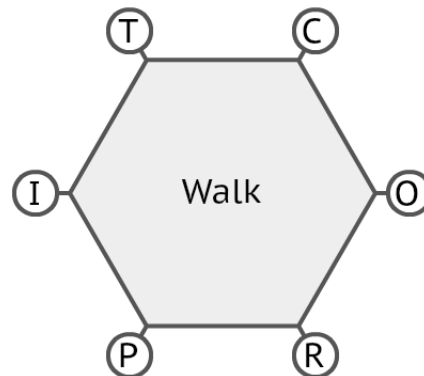


We need to know “what is walking in Tokyo station”.

How to Succeed in Tokyo St.?

What is “Walking in Tokyo Station”?

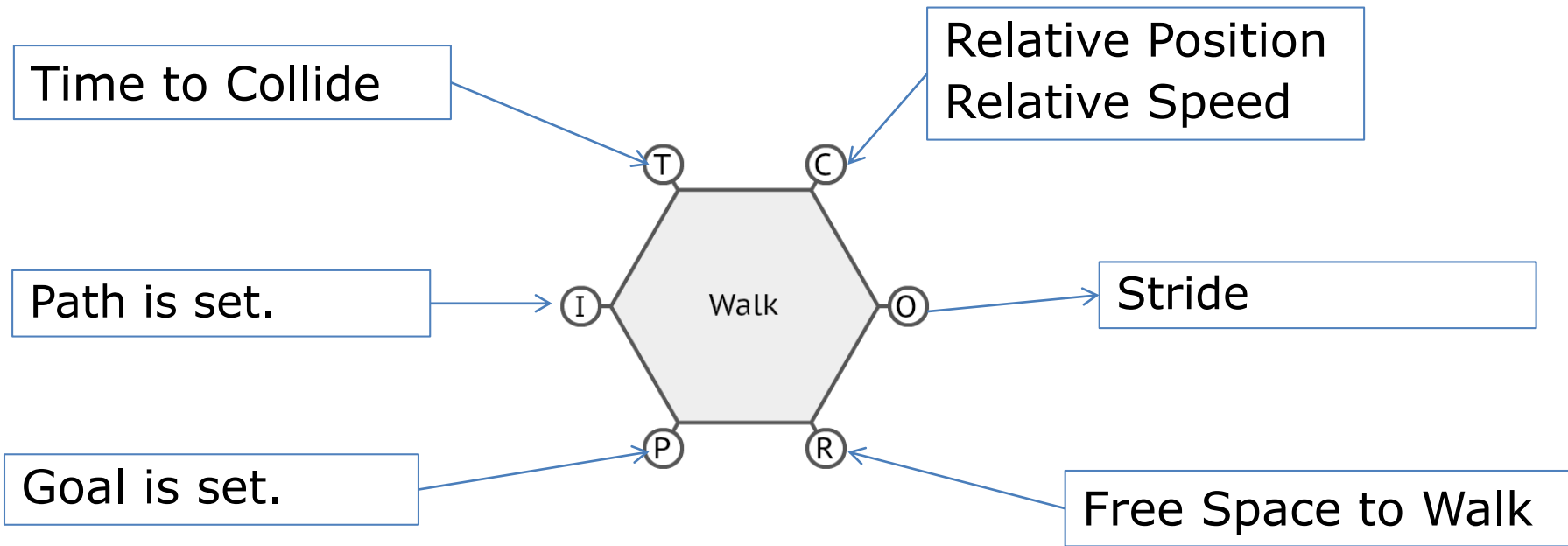
What are the Variables of “Walking in Tokyo?”



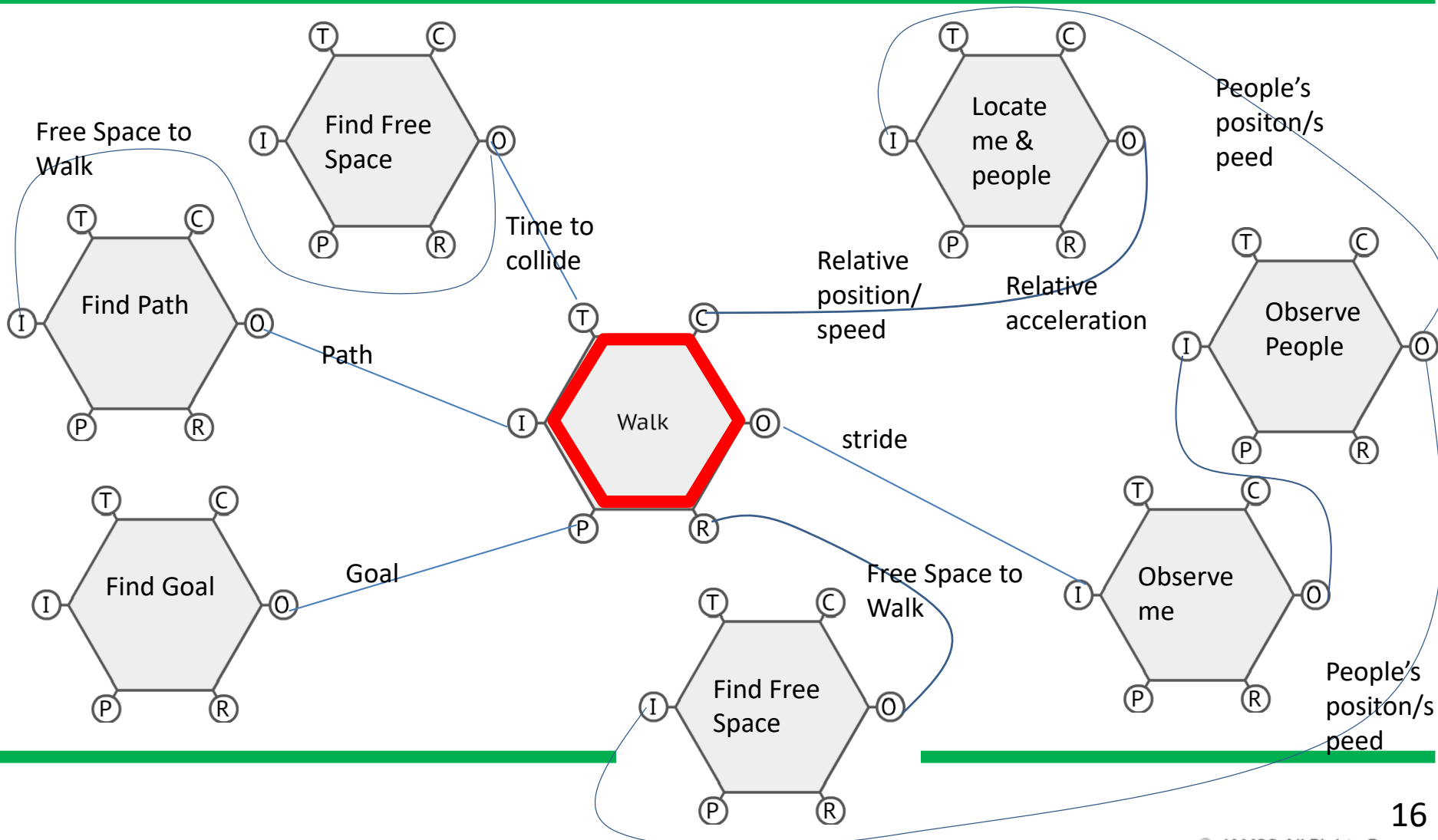
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What is “Walking in Tokyo Station”?

Unconscious maneuver like “Walk” takes all sorts of inputs (6 sense) to achieve goal.



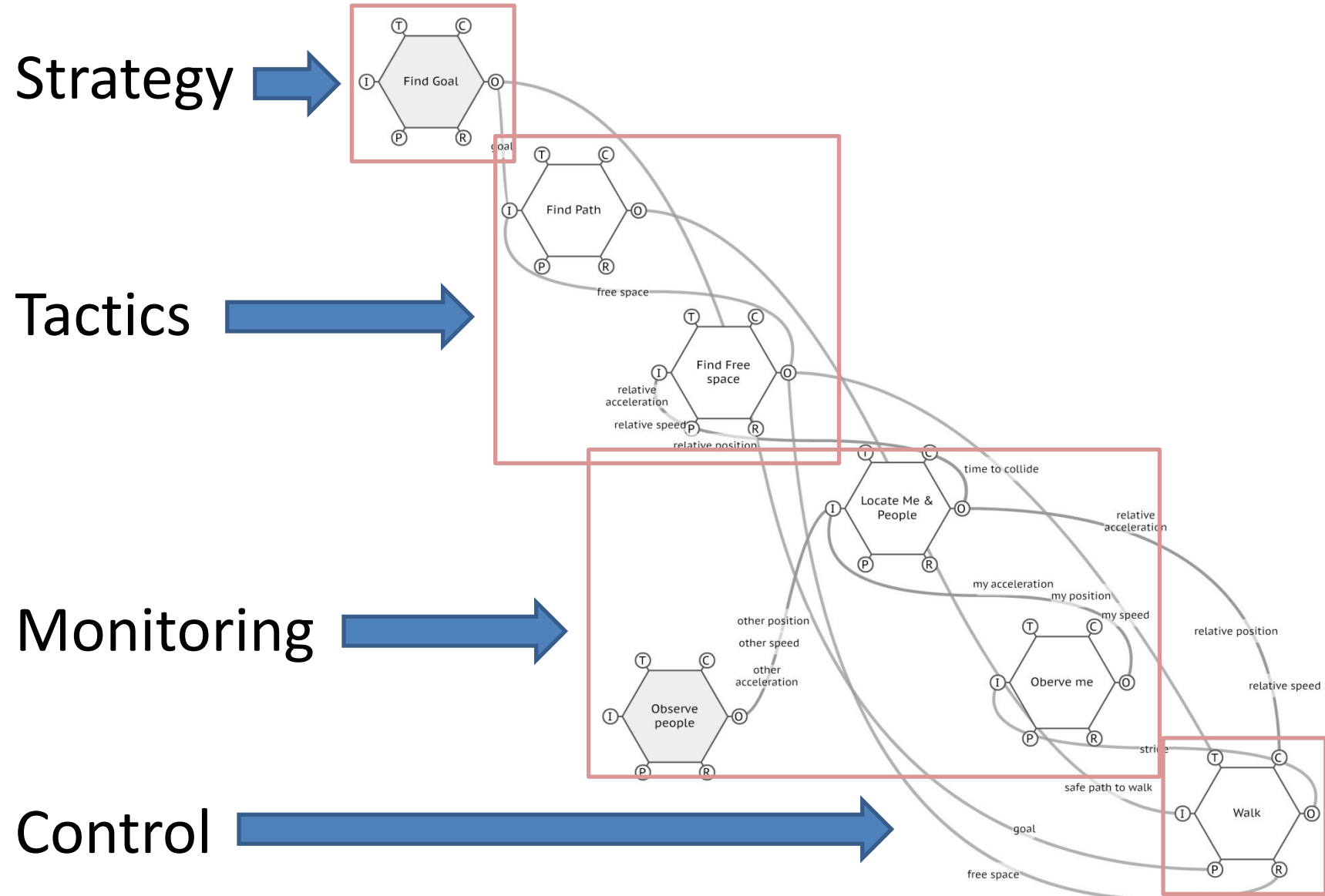
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How to Succeed in Tokyo St.?

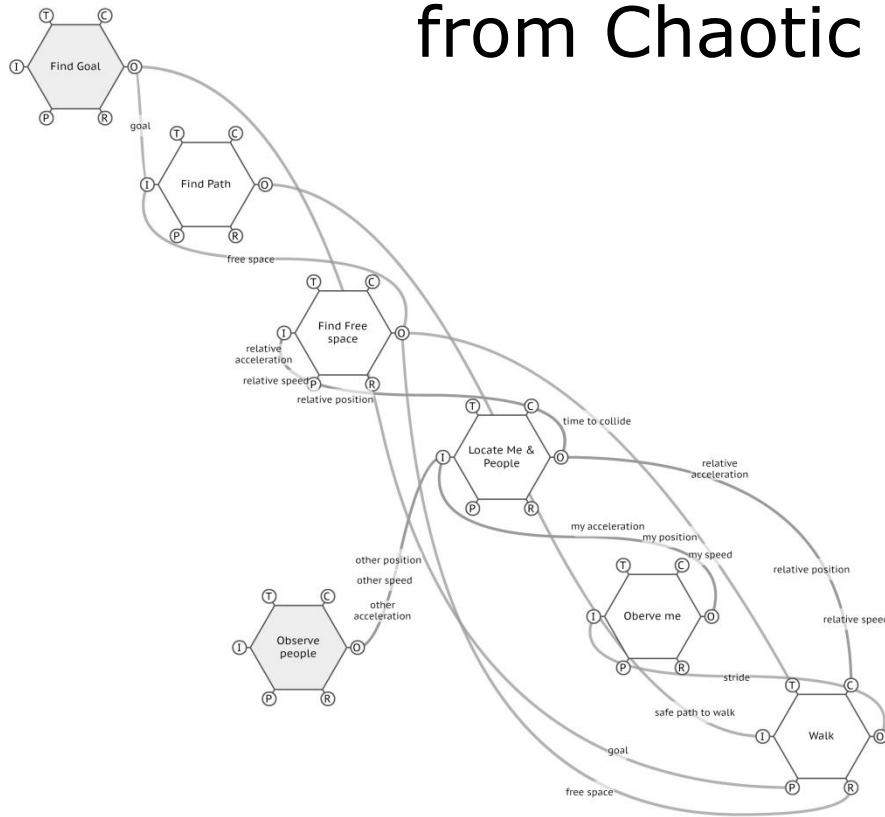


How to Succeed in Tokyo St.?

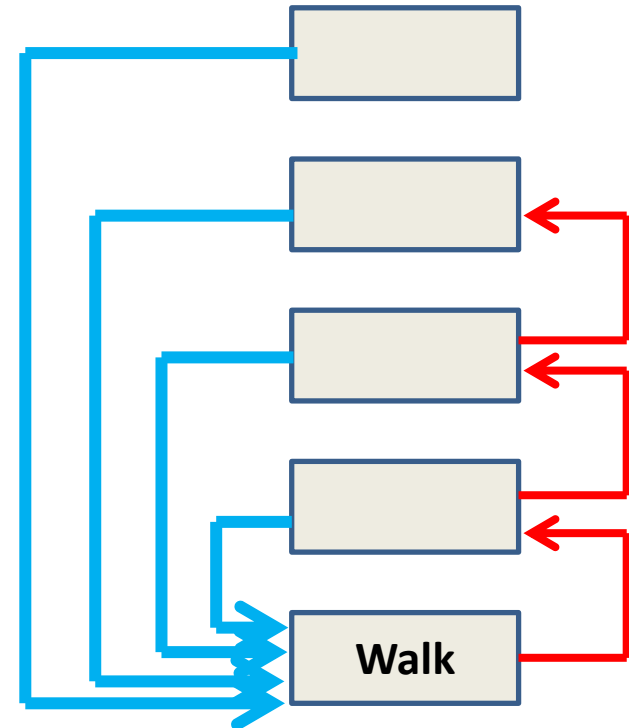


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Layered Structure is emerged
from Chaotic Tokyo Station



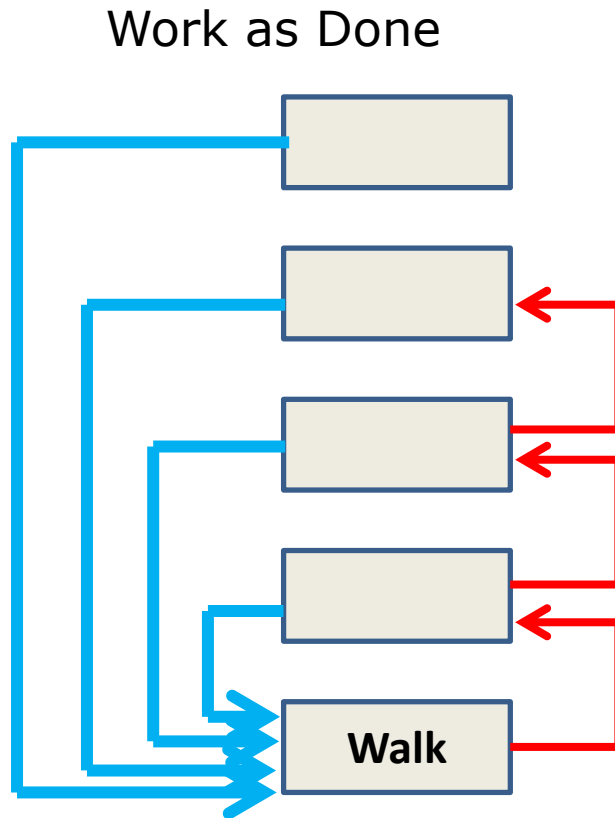
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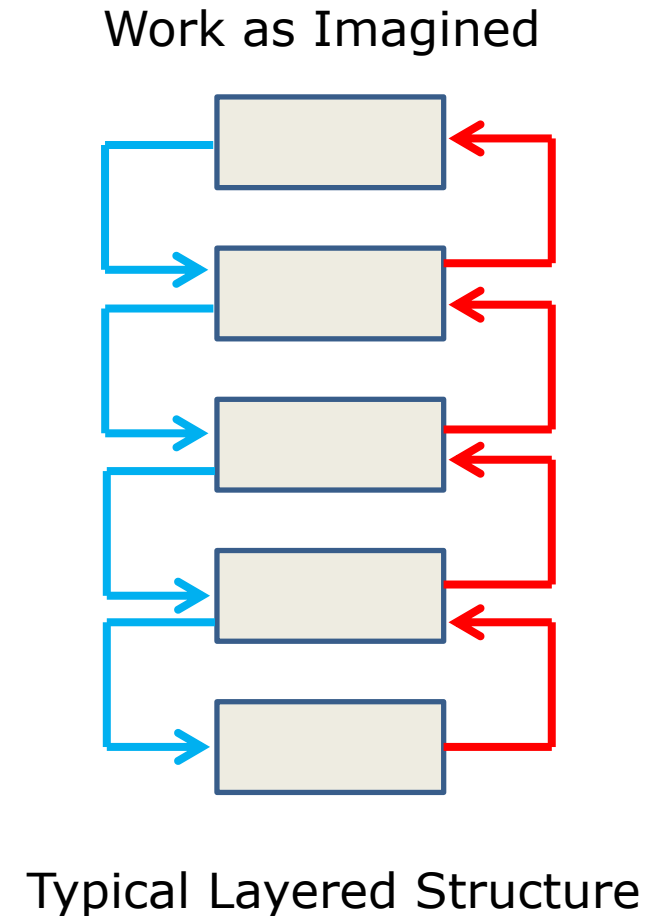
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Less Top-down structure.

More Bottom-up structure.

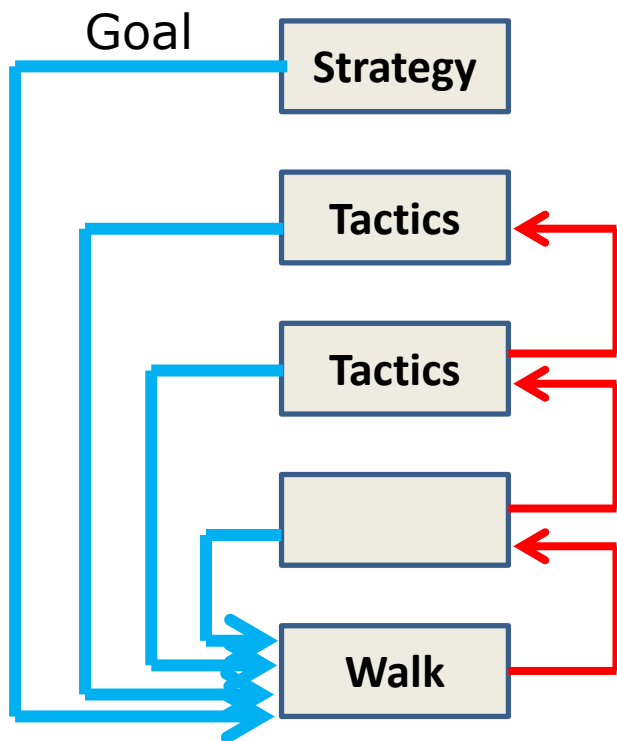


Walk in Tokyo



Typical Layered Structure

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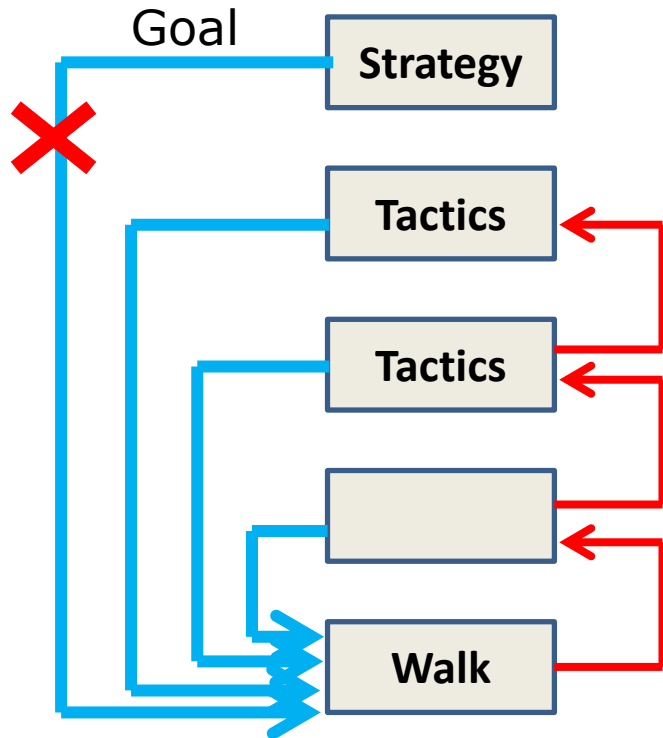


Why people can succeed in Tokyo ST.?

Once goal is given, everybody walks by the **tactics emerged in bottom-up manner**.

The tactics are automatically adjusted to changing situations because they are built bottom-up, not top-down.

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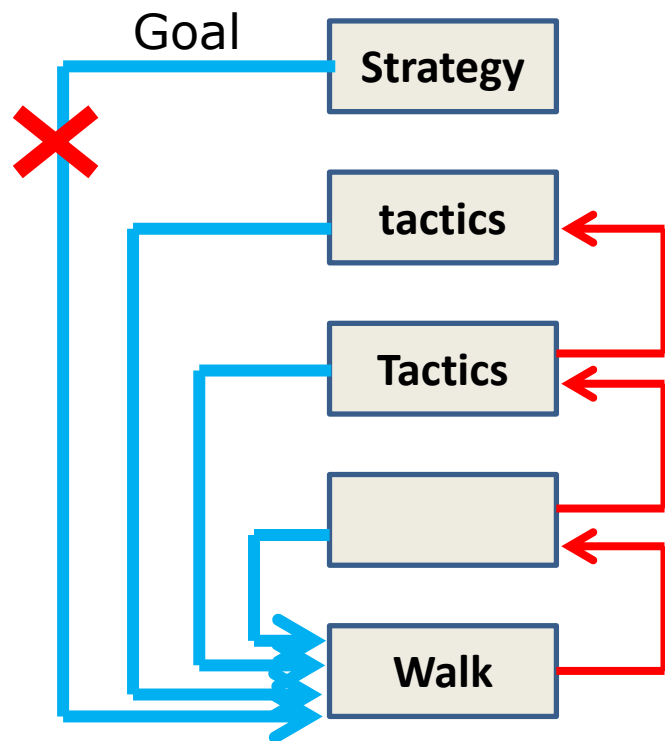
Success Factor

Tactics are extremely flexible.

No need to control people by top-down rule.

People can keep walking even if strategy is lost.

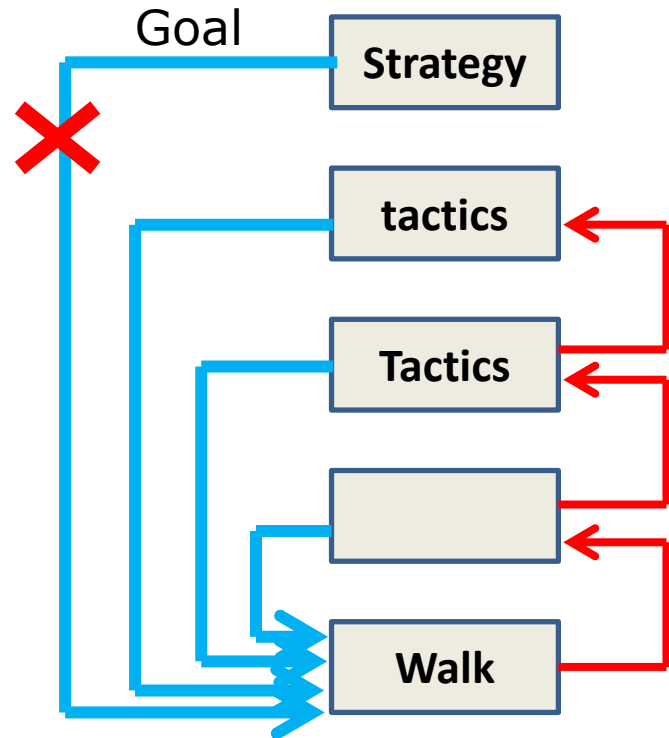
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Risk Factor

People start wandering aimlessly if the strategy is lost. The place will be easily filled with aimless people. *The success factor can be the risk factor at the same time. (Equivalence Principle)*

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Safety Approach

Strategy should be available anytime. (Place as many direction boards as possible, so anyone can see them from any position.)

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Craig Reynolds came up with the same bottom-up structure when he analyzed & simulated the behavior of flock of fish.

3 bottom-up rules:

- **Separation**: Avoid collision
- **Alignment**: Steer towards average heading
- **Cohesion**: Steer towards average position