The Design of a Self-healing Composition Cycle for Web Services

May Chan* and Judith Bishop

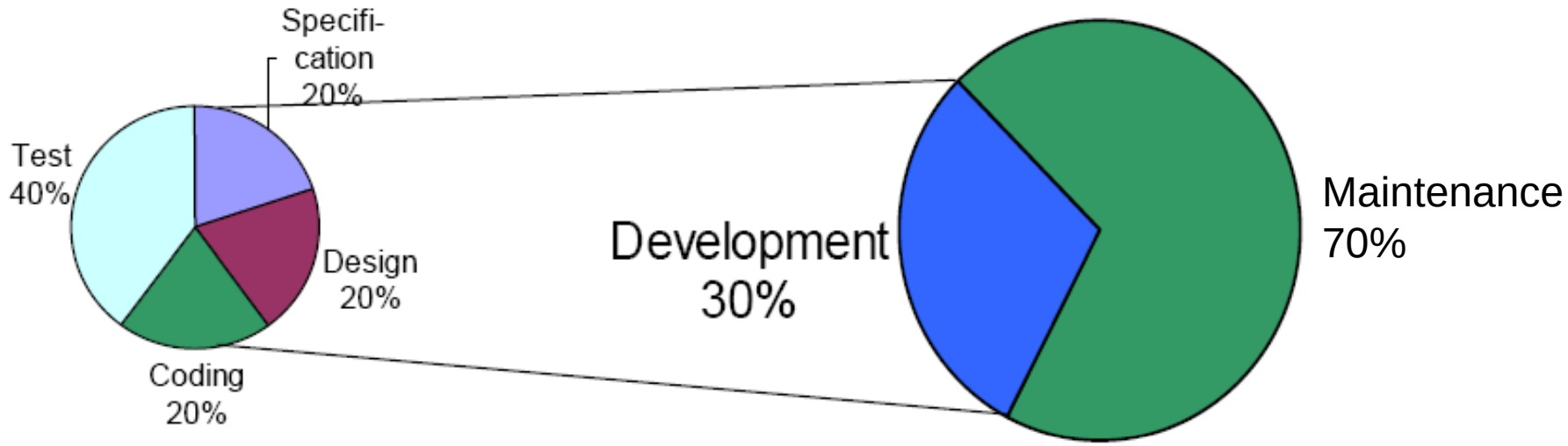
Polelo Research Laboratory
Department of Computer Science
University of Pretoria
Pretoria, South Africa

{ksmchan, jbishop}@cs.up.ac.za

**Also affliated with SAP Research*

Motivation

For ***complex*** computer systems to ***run***, ***adapt*** and ***repair*** themselves ***automatically***; they should be made ***less dependant*** on human intervention. Otherwise, more and more IT workers will be needed to ***sustain businesses*** that are interconnected via intranets, extranets, and the Internet.



50% - 80% of the time and cost are spent on maintenance.

Source: Erhard Plödereder, Code Analyses for Reengineering Maintenance and Software Audits. ISS 2009.

Definitions

automatic *adj.*

- (of a machine, device, etc., or its function) working by itself, without direct human intervention.

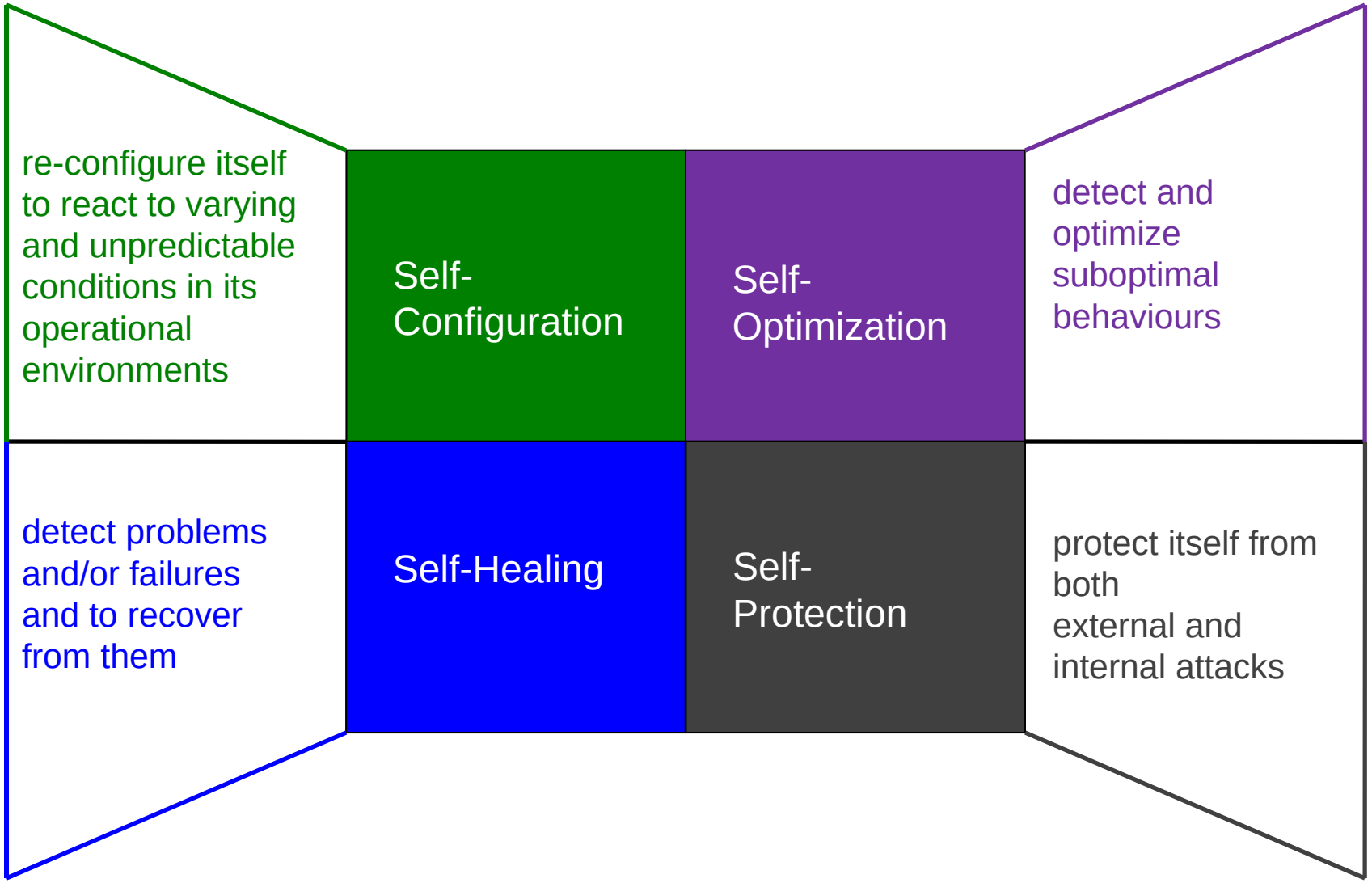
autonomic *adj.* esp. *Physiol.*

- functioning involuntarily
- relating to or controlled by the autonomic nervous system

autonomous *adj.*

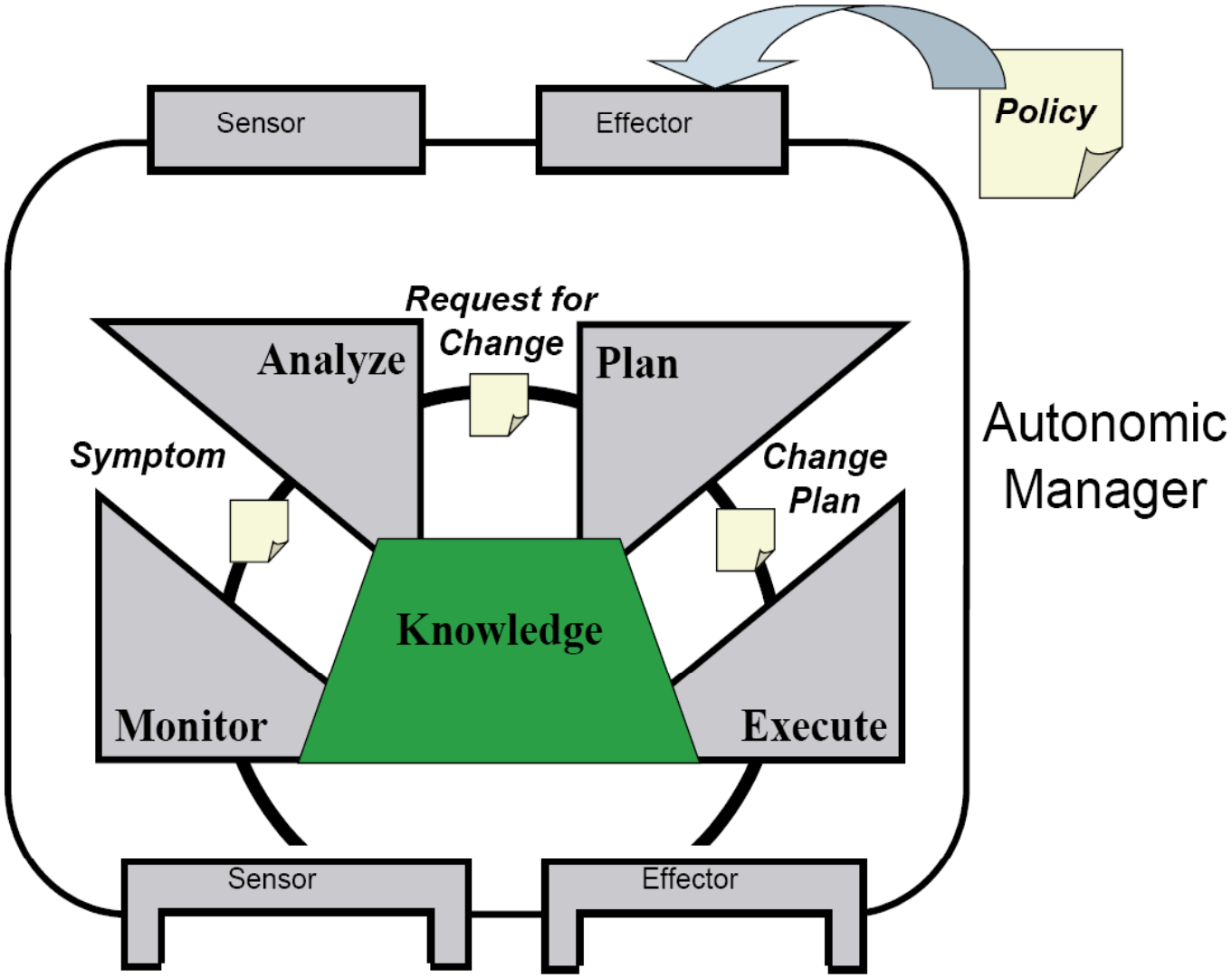
- having self-government
- acting independently or having the freedom to do so

Autonomic Computing System



MAPE Cycle

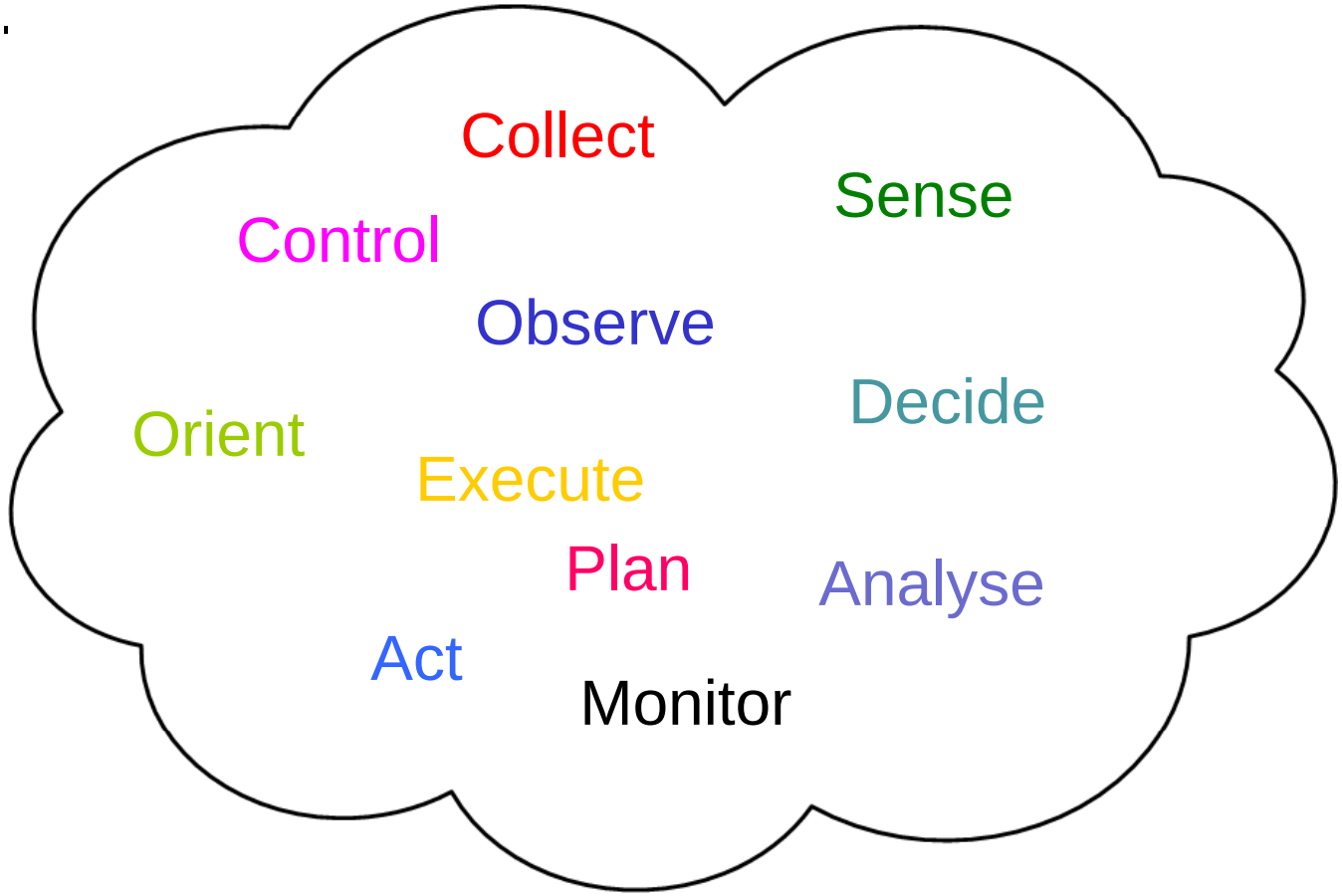
- contains an intelligent control cycle that monitors activities and takes actions to adjust the system to meet business objectives
- learn from past experience to build action plans



Source: IBM, An architectural blueprint for autonomic computing (4th edition). June 2006.

Cycle / Loop / Model

- Robotics (e.g. SPA)
- Military Command and Control (e.g. OODA)
- etc.



Terminologies

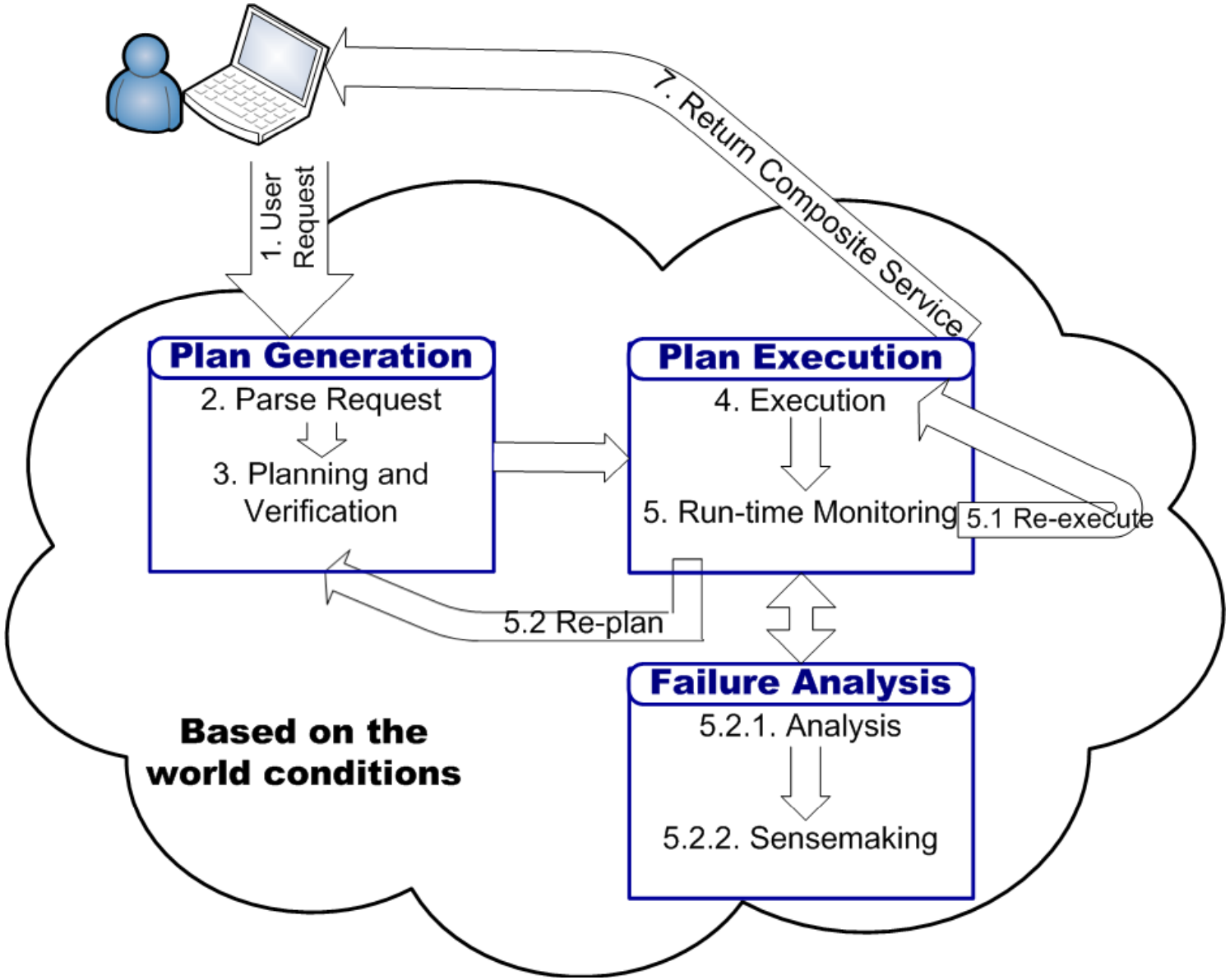
A ***plan*** is a composition workflow.

A ***planning system*** (***planner***), is a system that generates the composition workflow. Responsible for the execution of the workflow generated.

An ***execution monitor*** is a mechanism that monitors the execution of the composition. Reporting abnormal behaviours.

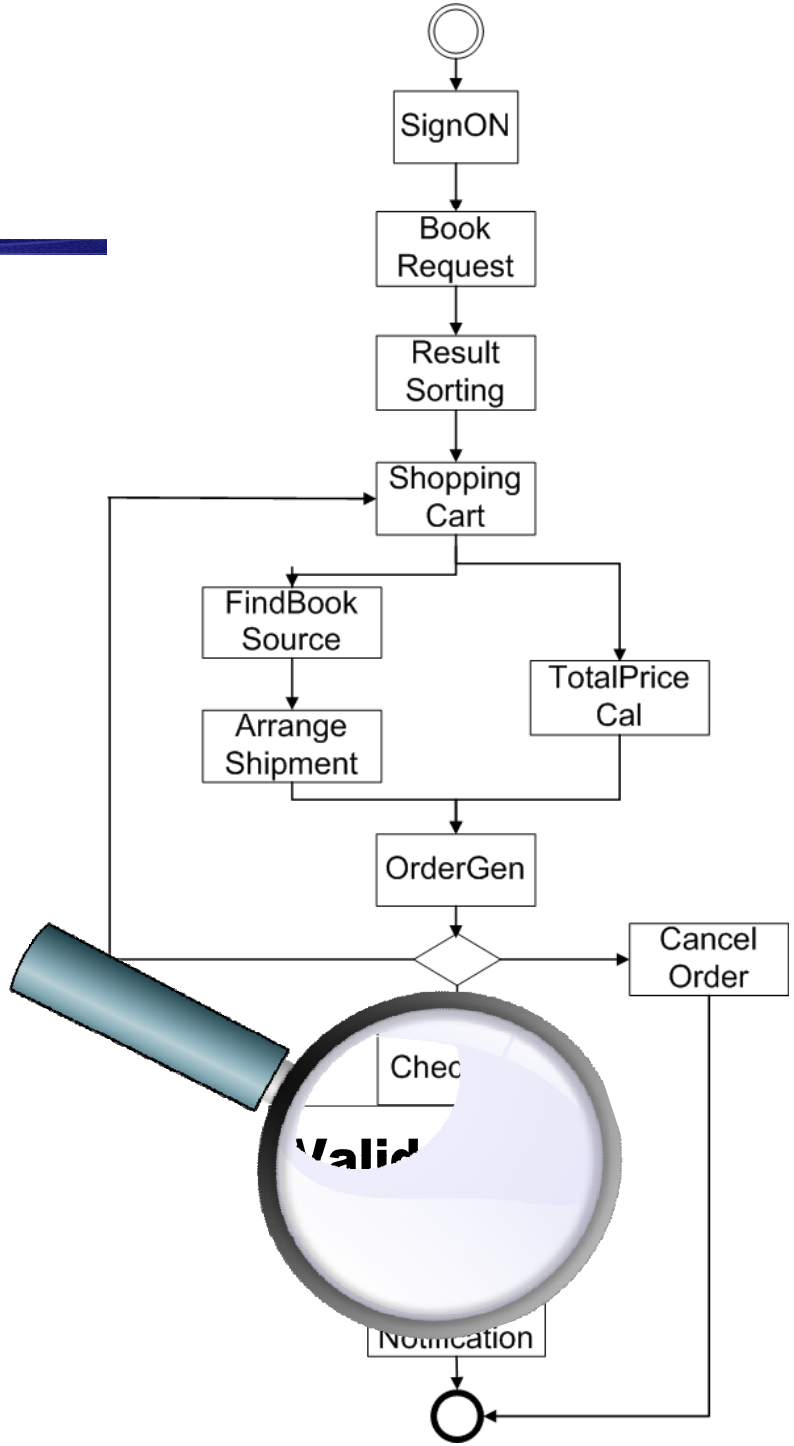
Sensemaking is the process of creating situation awareness and understanding in situations of high complexity or uncertainty in order to make decisions.

Self-healing Composition Cycle

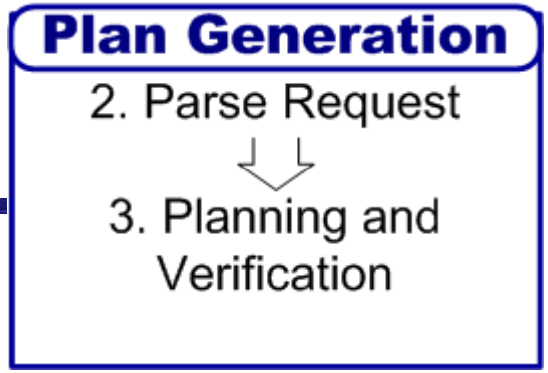


Bookstore Example

- Violation of capacity/size
- Violation of value domains
- Response error
- Violation of non-functional requirements

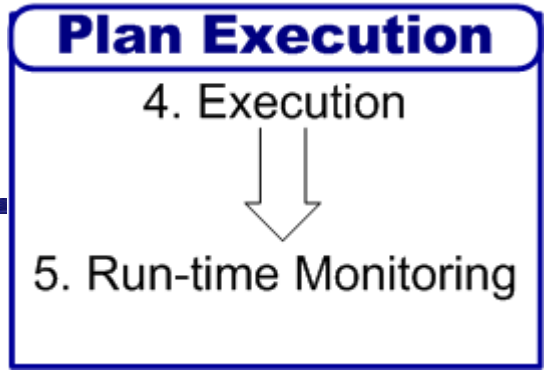


Plan Generation



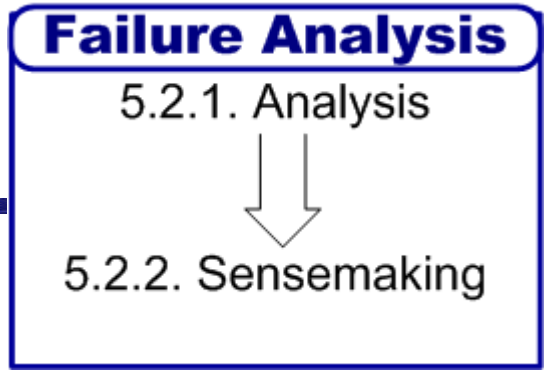
- Syntactically (BPEL)
  - *BPEL4WS 2 OWL-S*
- Semantically (OWL-S)
  - *SiTra*
- Verification
  - e.g. model-based
- AI planning

Plan Execution



- Closed world assumption
- Real-world situation: dynamic, unstable and unpredictable
- Monitoring criteria
  - `ResultSorting` *(e.g. book image .tiff)*

Sensemaking



1. The abnormal behaviour was unexpected.

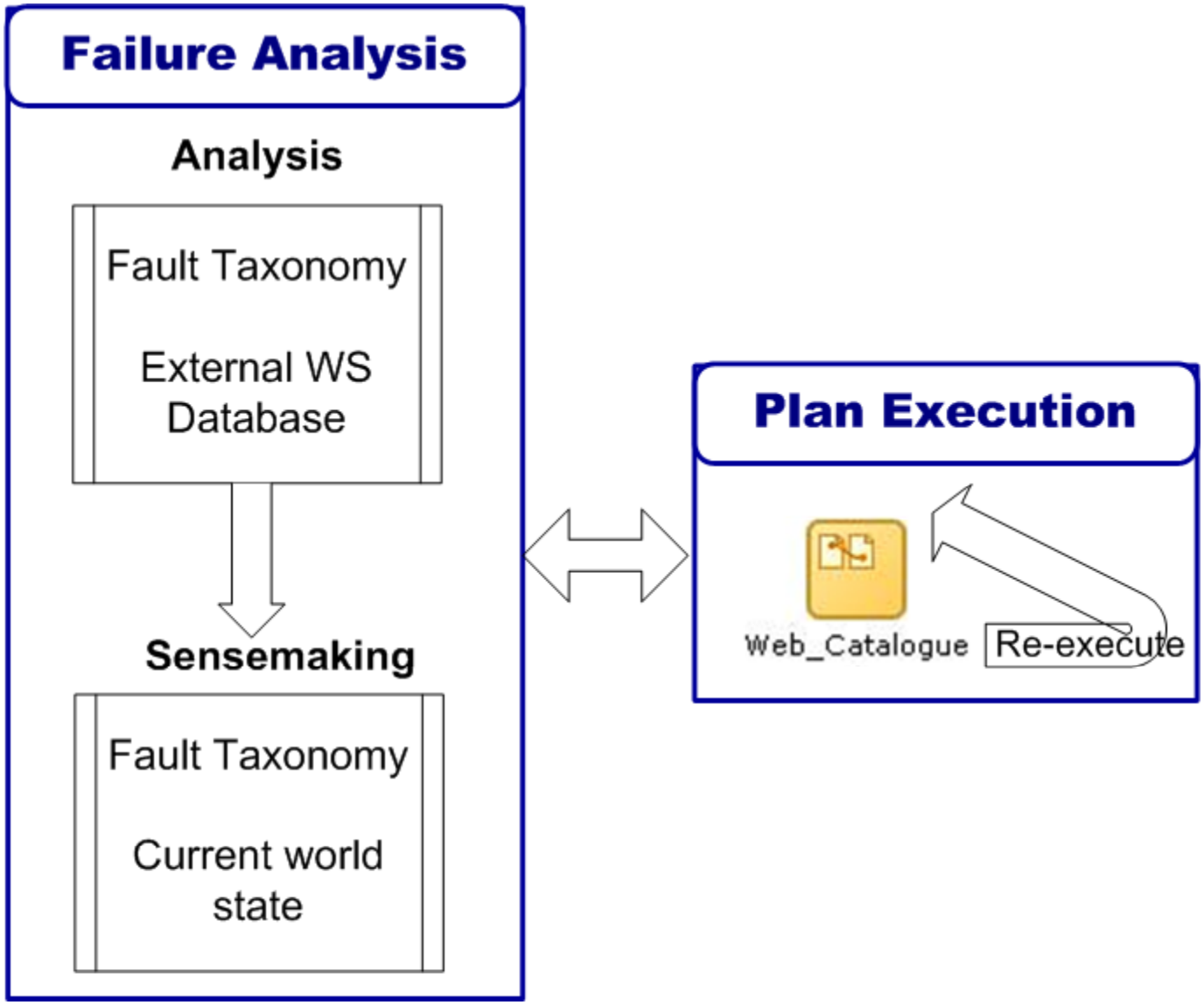
2. The abnormal behaviour was predicted but no contingency plan was prepared.

3. The abnormal behaviour was predicated and a contingency plan was prepared, but failed.

Sensemaking

Analysis

Web Catalogue Example



Dynamo and SHIWS

Requirements	Dynamo	SHIWS
Verification	+	+
Run-time monitor	+	+
Analysis	+	+
Sensemaking	-	-
Recovery strategies	+	+/-
Execution (resume)	+	+

Summary and Outlook

Summary

- Requirements for self-healing Web services composition
- Self-healing composition cycle
- Application through evaluation

Outlook

- Comprehensive comparison criteria
- Framework - automatically compare self-healing techniques

"… perfect systems are something to be aspired to rather than achieved."

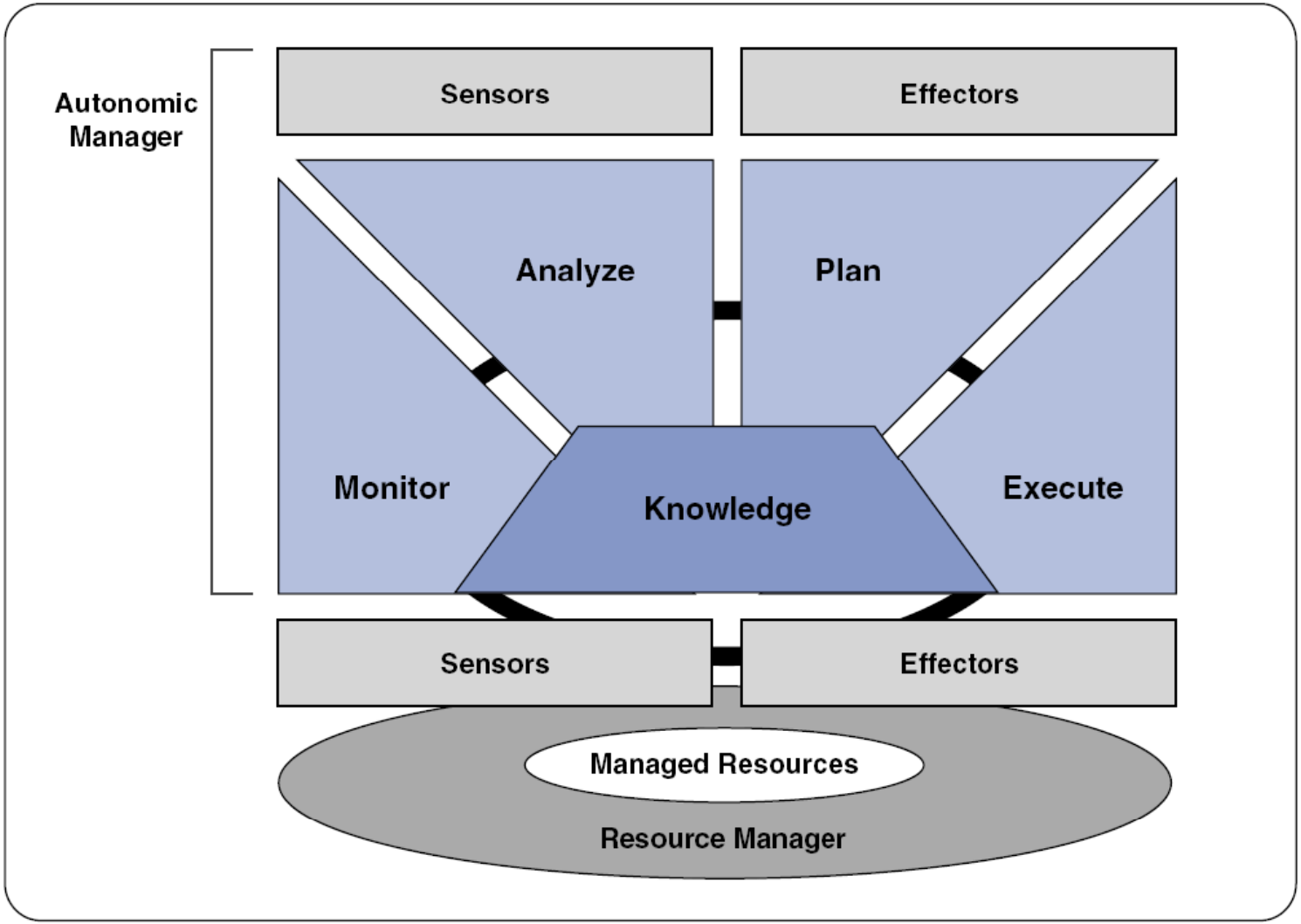
- T. Anderson and P.A. Lee

Thank You!

Now…

OR later (ksmchan@cs.up.ac.za)

MAPE Cycle



In an autonomic computing architecture, control loops facilitate systems management.

Possible Solution

- Violation of capacity/size
  → **Proxy**
- Violation of value domains
  → **Decorator/Proxy**
- Response error
  → **Decorator**
- Violation of non-functional requirements
  → **Decorator/Proxy**