Dynamic Self-Adaptive Software Technology Using Collective Intelligence

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Introduction — IT Ecosystem

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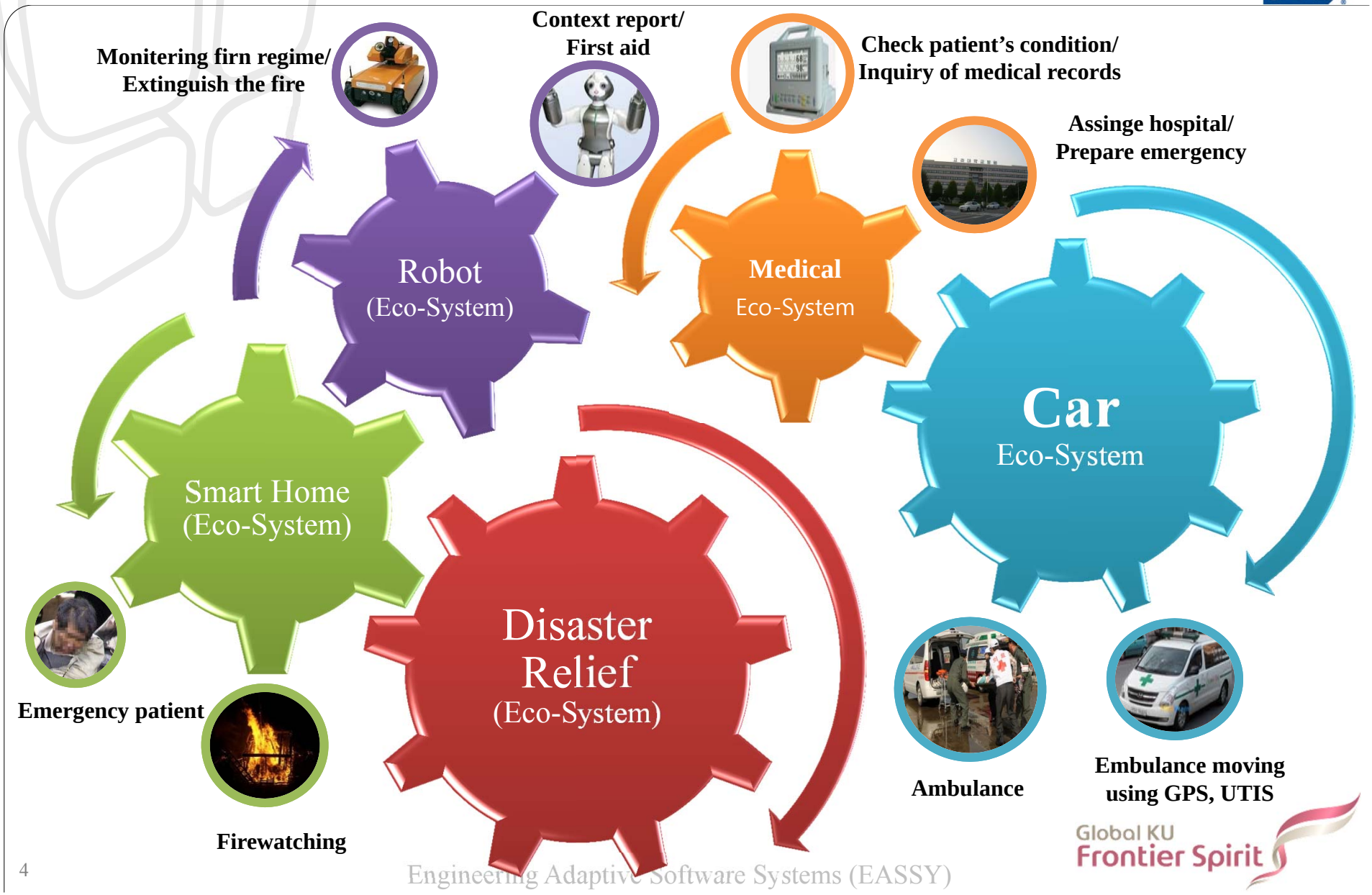
VS

Collaboration, Participation, Sharing, …

Introduction — Mega Ecosystem



Challenges

SE support for Adaptization

Software Engineering methodology and tools
To transform from existing non-adaptable software to adaptable software systematically

Research Trends/Focus

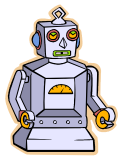
	Current Research	Our Research Focus
System-Driven	• One Robot / Homogeneous	• Multiple Robots / Heterogeneous
System-Driven	• Centralized Decision	• Distributed Decision
System-Driven	• Simple Knowledge Based (Syntactic)	• Ontological Knowledge Based (Semantic)
SW-Driven	• Adaptive System	• Adaptive System of Systems
SW-Driven	• Ad-hoc Design	• Adaptization

Our Focus: Heterogeneous

- **Self-Adaptive Mechanism for Multiple Robots(Systems)**
  - **Interaction** among systems
- **Knowledge interoperability between heterogeneous systems/robots**
  - Data **interoperability**

One Robot / Homogeneous

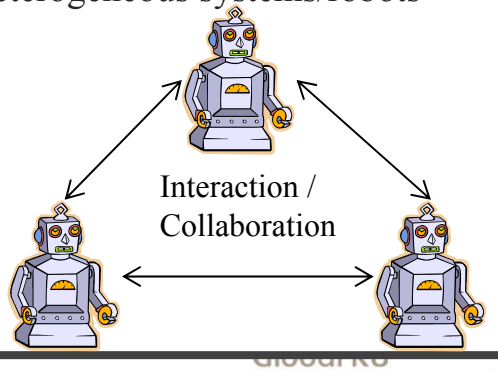
- Single Processing
- Self-Adaptive system for single system (homogeneous)



Extension

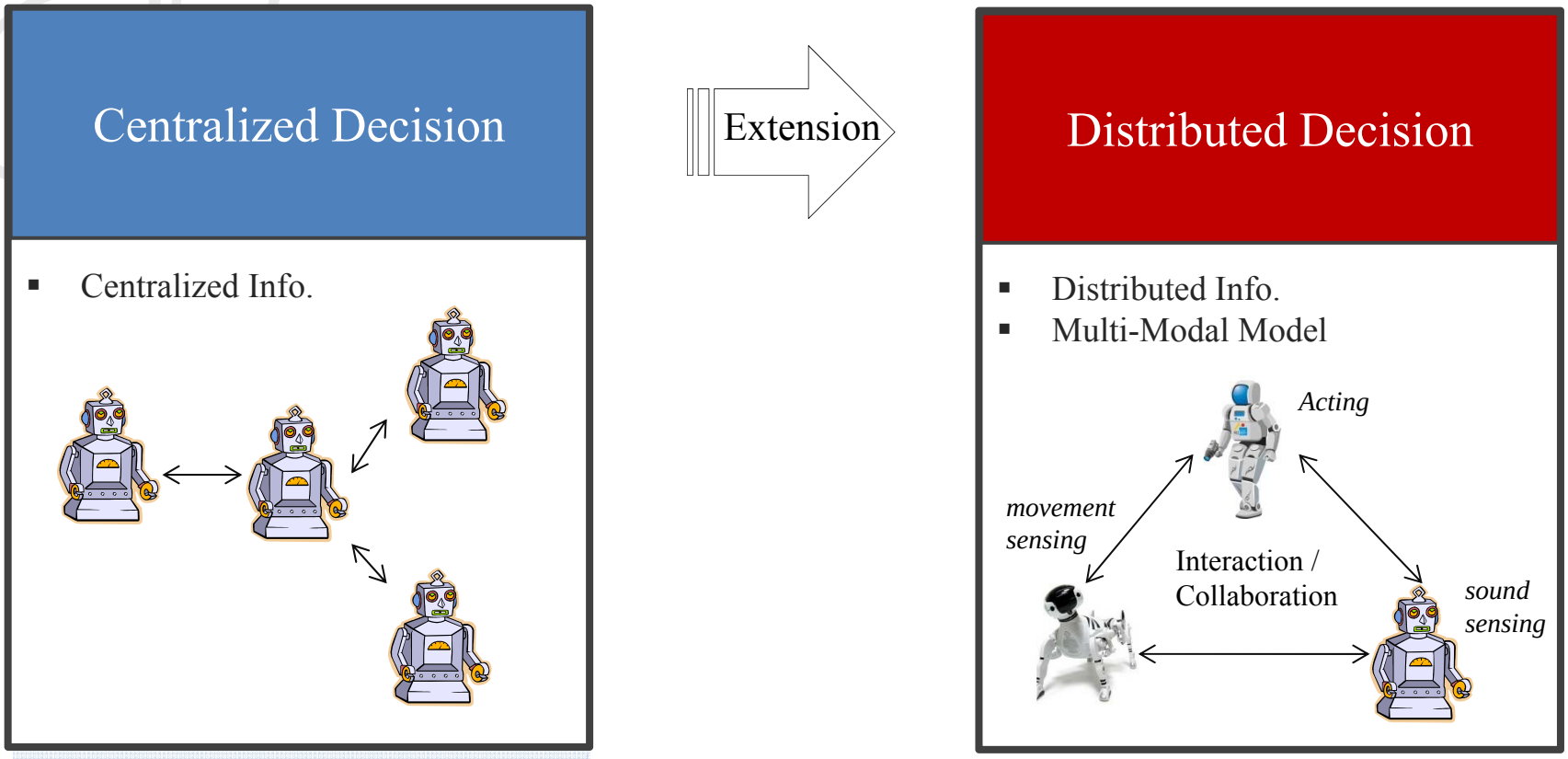
Multiple Robots / Heterogeneous

- Collaboration & Cooperation Model
- Negotiation Model
- Self-Adaptive system for heterogeneous systems/robots



Our Focus: Distributed

➢ **Distributed Decision**

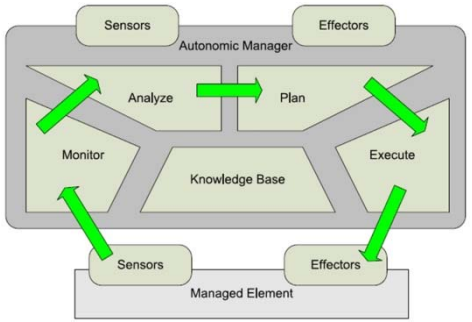


Our Focus: Semantic KB

- **Ontological KB**
  - Expression power ➔ sophisticated reasoning
  - Reuse of knowledge ➔ means of communication in SoS
  - Interoperability support ➔ overcome heterogeneity

Simple Knowledge Based (Syntactic)

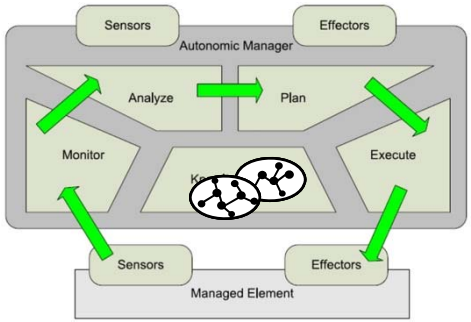
- Centralized KB/Info.
- Full KB



Extension

Ontological Knowledge Based (Semantic)

- Distributed KB/Info.
  (Decentralized Approaches for Self-Adaptation in Agent Organizations, TAAS, 2012)
- Partial KB

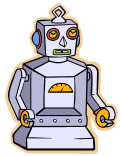


Our Focus: System of Systems

- **Adaptive System of Systems (SoS)**
  - Using Collective Intelligence
  - Model for Interoperability, Communication, Cooperation, Collaboration

Adaptive **System**

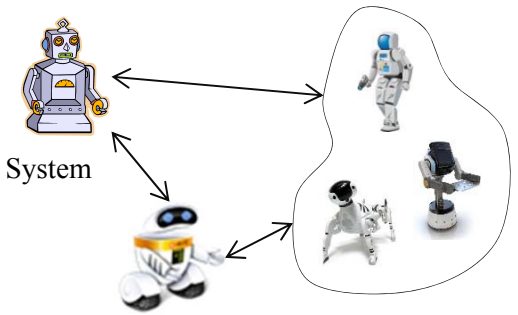
- Approach to Single robot / one adaptive system



Extension

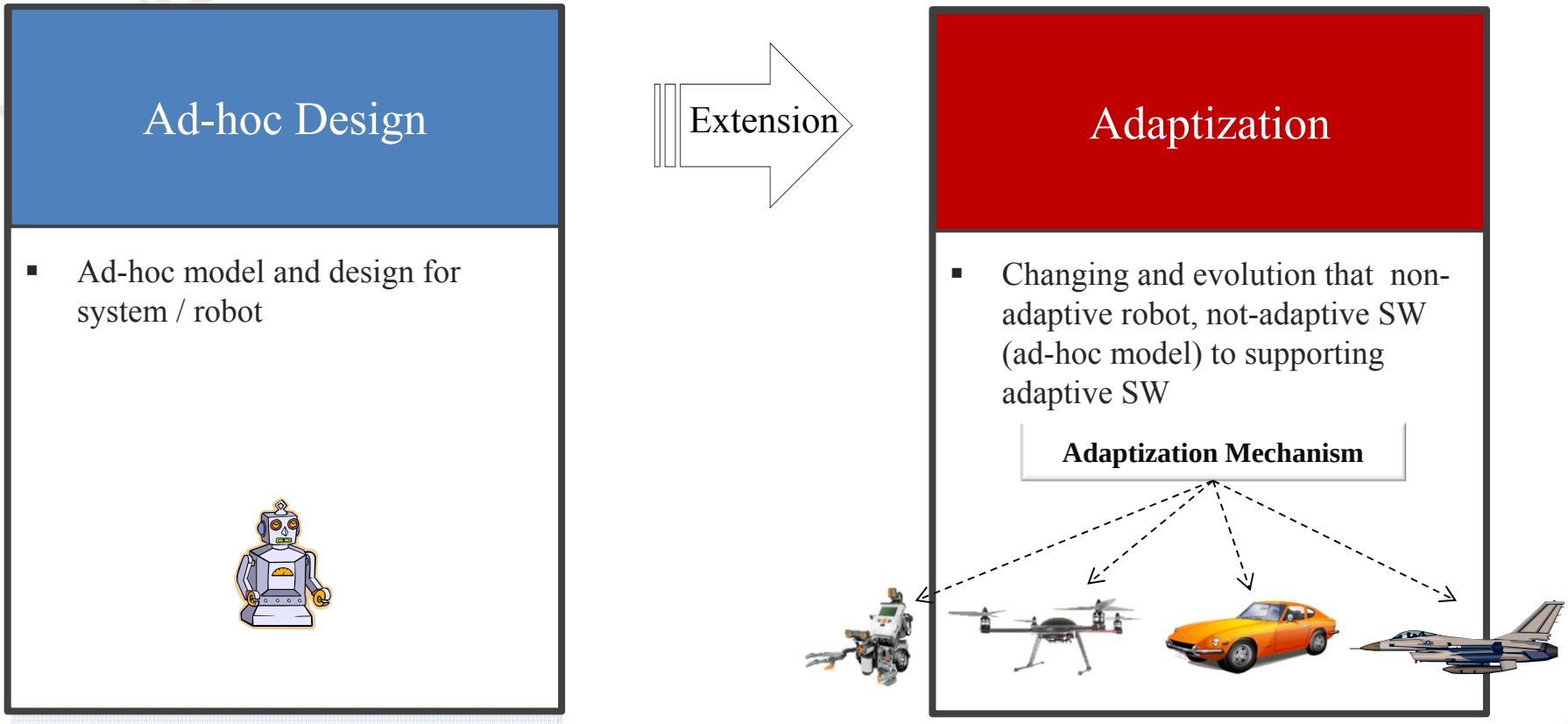
Adaptive **System of Systems**

- Approach to dynamic adaptive product line



Our Focus: Adaptization

- **Adaptization**
  - Transform existing non-adaptable software to adaptable software by providing methodology and tools



Proposed Work

M → A → P → E

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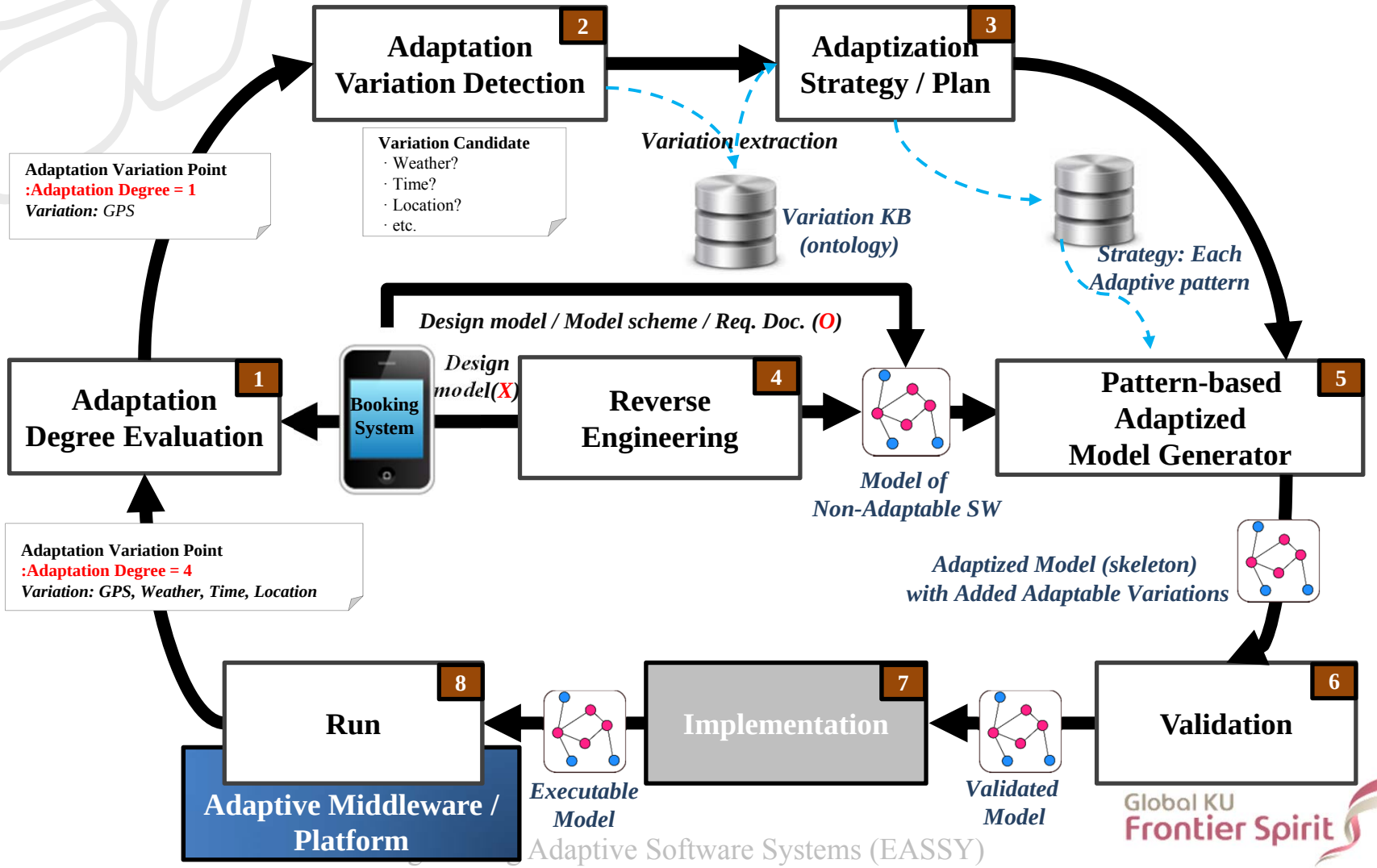
❖ **Dynamic self-adaptive software technology using collective intelligence**



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Proposed Work — Issues 1

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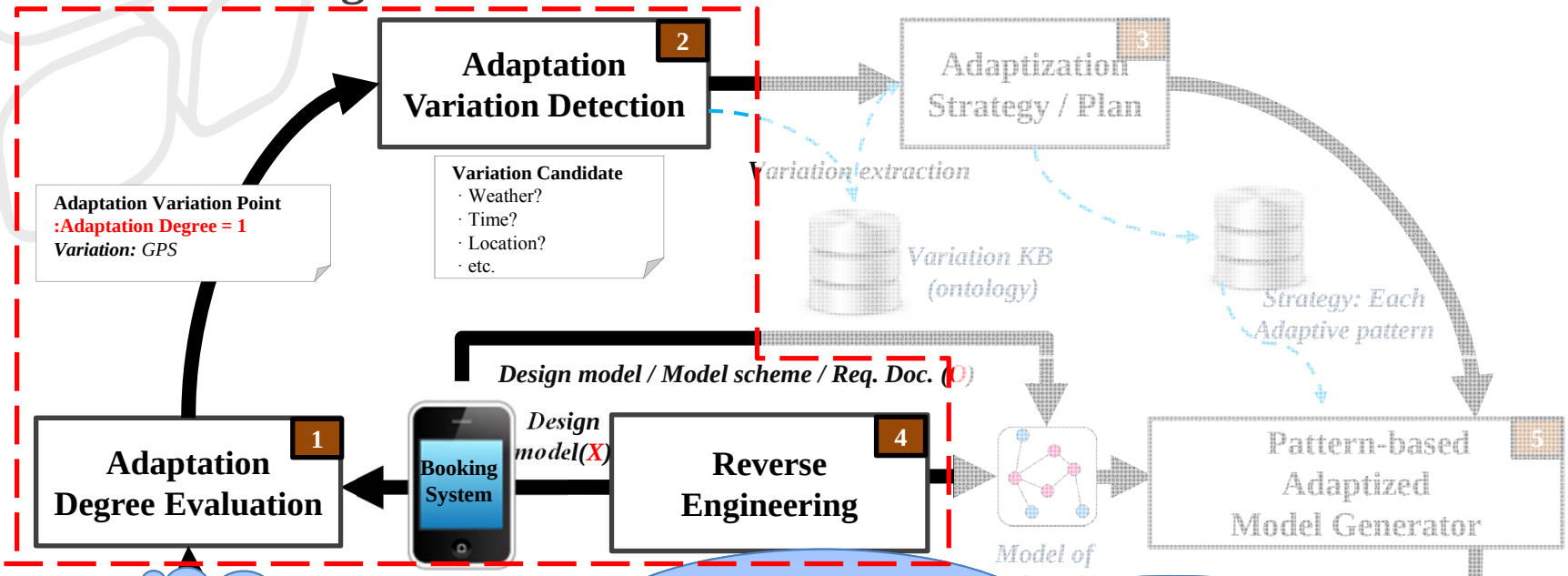
❖ **A research on situation-aware based self-adaptive software system modeling and monitoring**



- **Reverse Engineering**
  - Integrated automation tool for detecting Self-Adaptive Monitoring Factor
- **Adaptation Degree Evaluation**
  - Extended situation-aware and system modeling language.
  - Developing a quantitative and reasonable evaluation method of non-adaptable software or converted self-adaptive software as adaptation level
- **Adaptation Variation Detection**
  - To define self-adaptive services and match it with self-adaptive monitoring factor in current self-adaptation level of the non-adaptable software

Proposed Work — Issues 2

M → A → P → E

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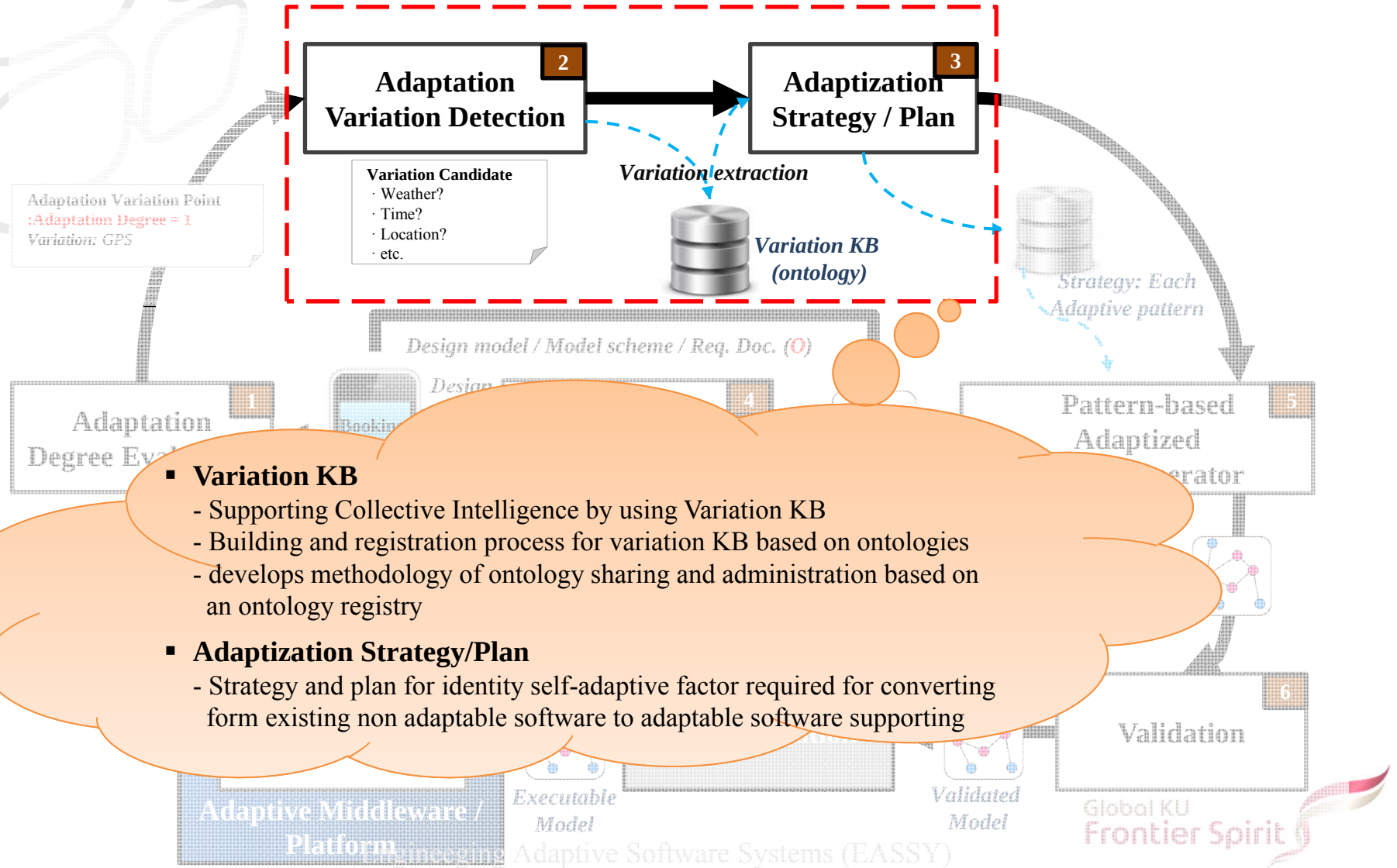
❖ **Collective intelligence-based self-diagnosis for problem analysis**

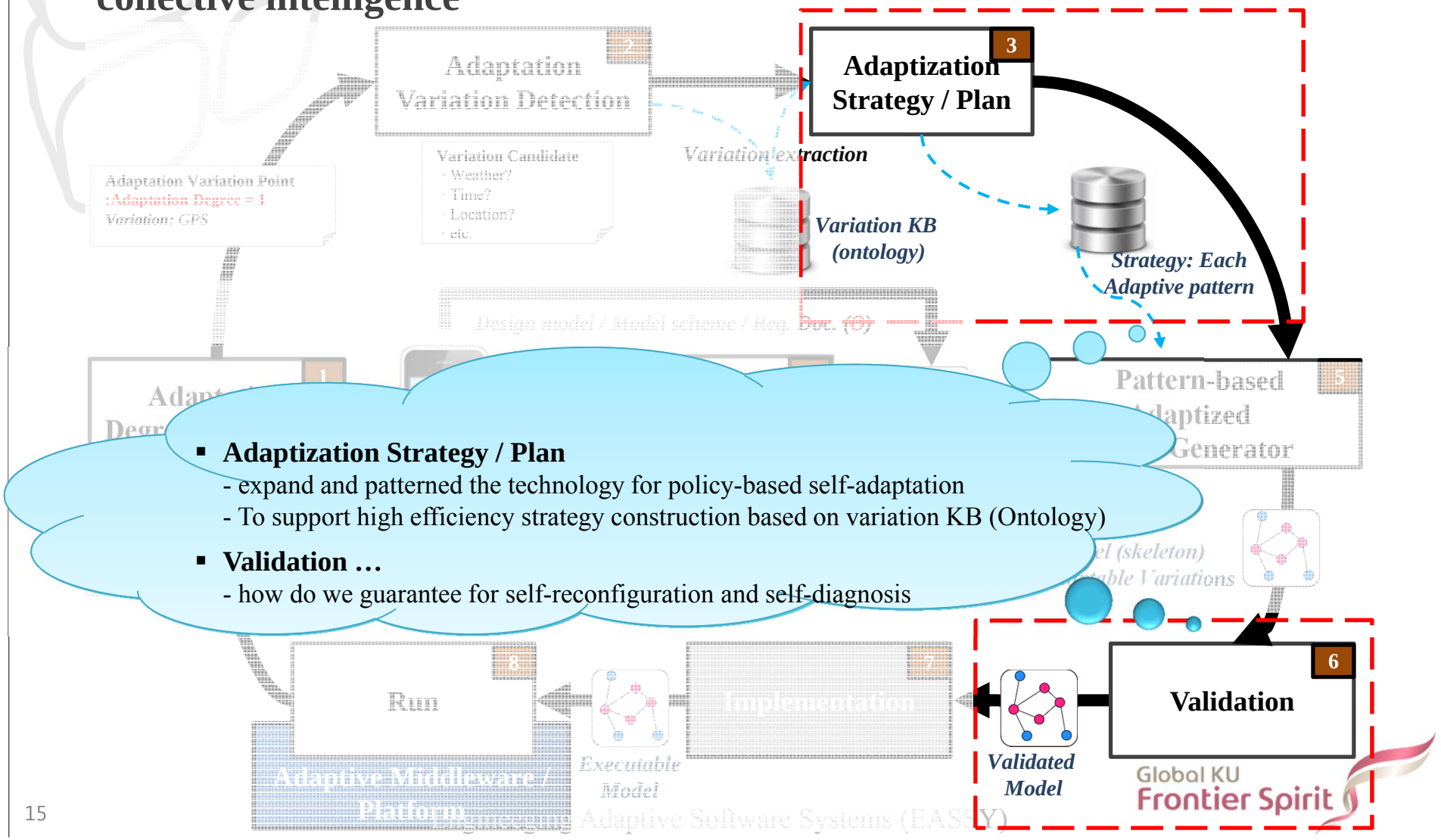


- **Variation KB**
  - Supporting Collective Intelligence by using Variation KB
  - Building and registration process for variation KB based on ontologies
  - develops methodology of ontology sharing and administration based on an ontology registry
- **Adaptization Strategy/Plan**
  - Strategy and plan for identity self-adaptive factor required for converting form existing non adaptable software to adaptable software supporting

Proposed Work — Issues 3

M A P E

❖ **Development of a technique for self-growing adaptation strategy based on collective intelligence**



- **Adaptization Strategy / Plan**
  - expand and patterned the technology for policy-based self-adaptation
  - To support high efficiency strategy construction based on variation KB (Ontology)
- **Validation …**
  - how do we guarantee for self-reconfiguration and self-diagnosis

Proposed Work — Issues 4

M A P E

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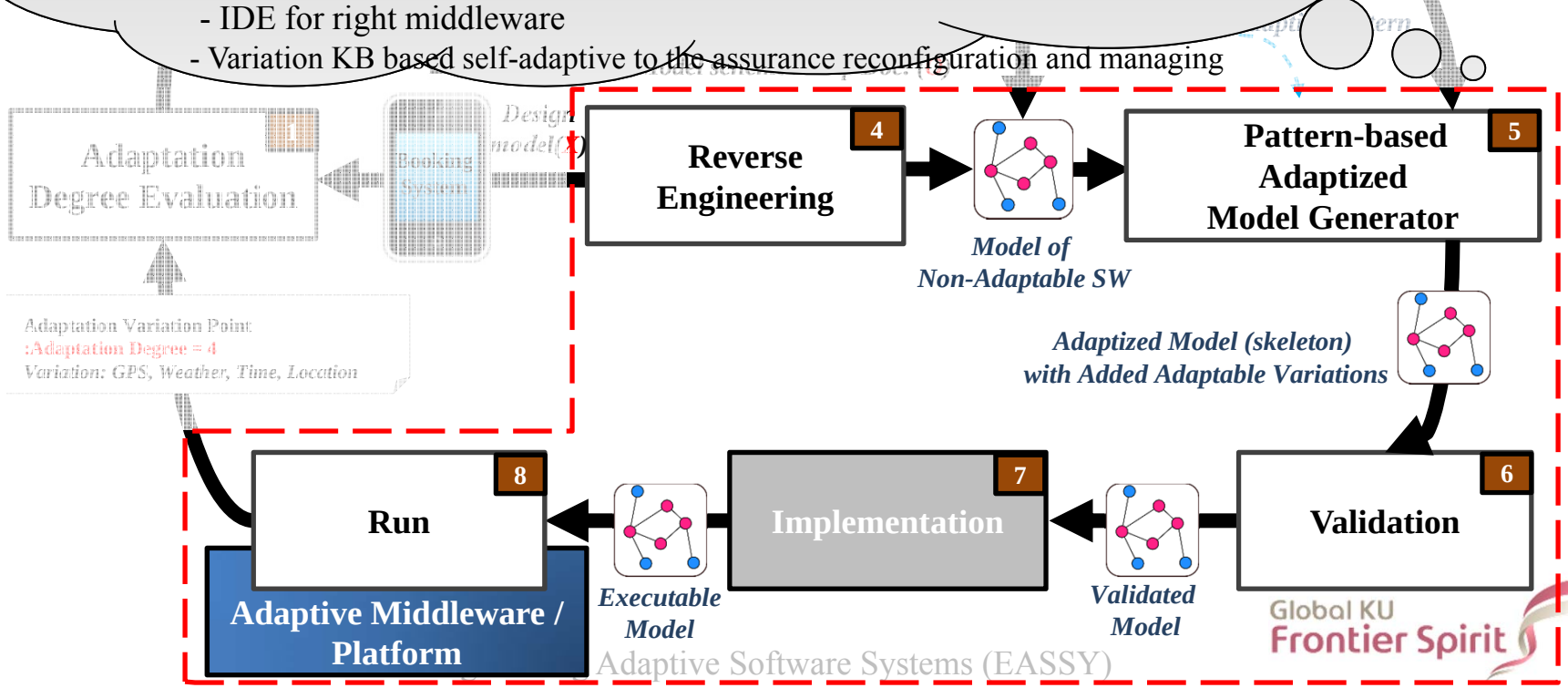
❖ **Development weaving adaptive pattern into non-adaptable software and middleware**

- **Reverse Engineering**
  - To convert from non-adaptable software to self-adaptable software by reverse engineering techniques.
- **Weaving Pattern model**
  - Researching reverse engineering for weaving adaptive pattern into non-adaptable software for adaptive software.
- **Middleware for Self-Adaptive Software**
  - IDE for right middleware
  - Variation KB based self-adaptive to the assurance reconfiguration and managing



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Q / A

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Thank You

For Your Attention !

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