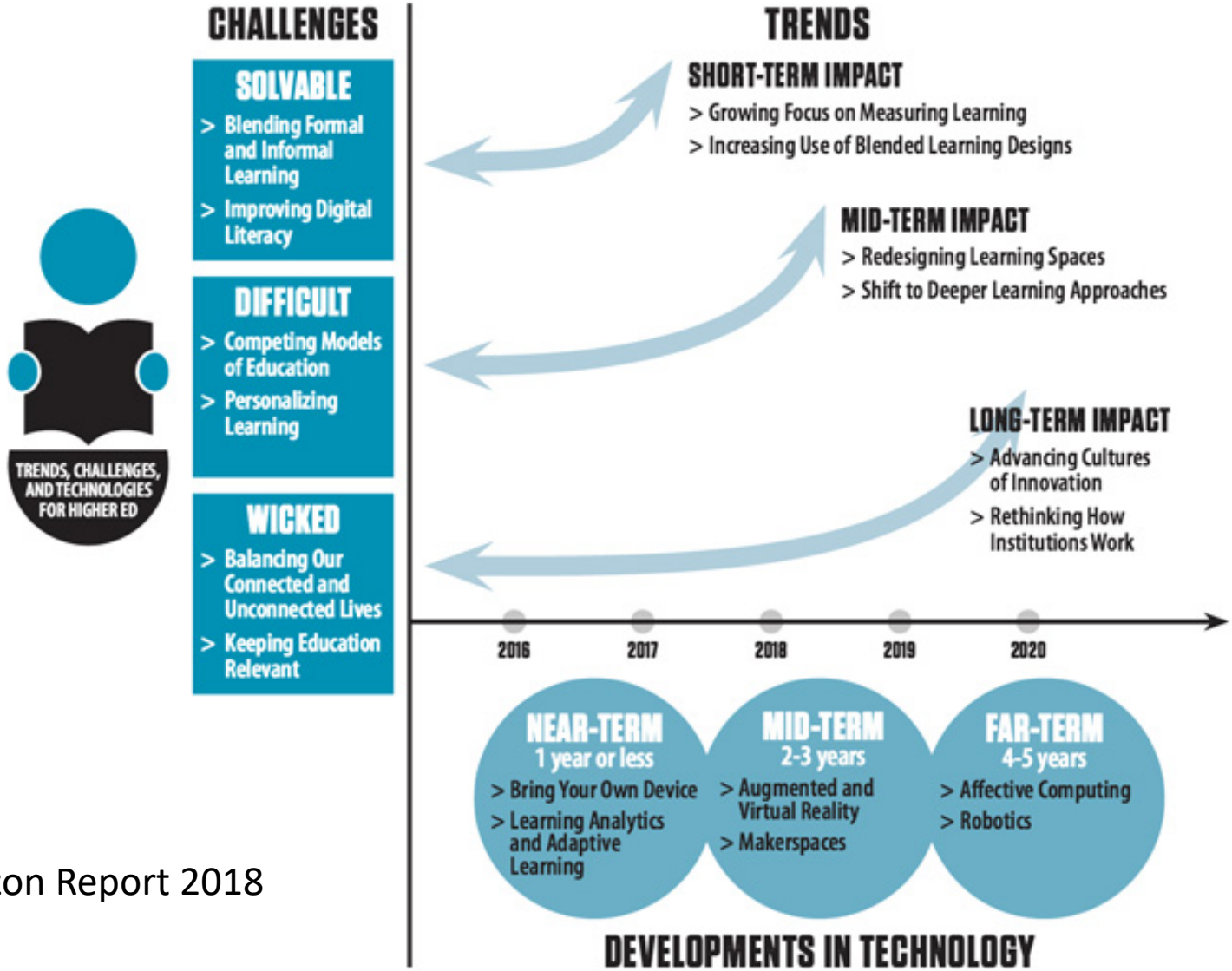
Data Science and the Learning Journey in Higher Education

David Gibson
Curtin University

Director Learning Futures
UNESCO Chair of Data Science in Higher Education Learning & Teaching

Global Trends in Higher Education

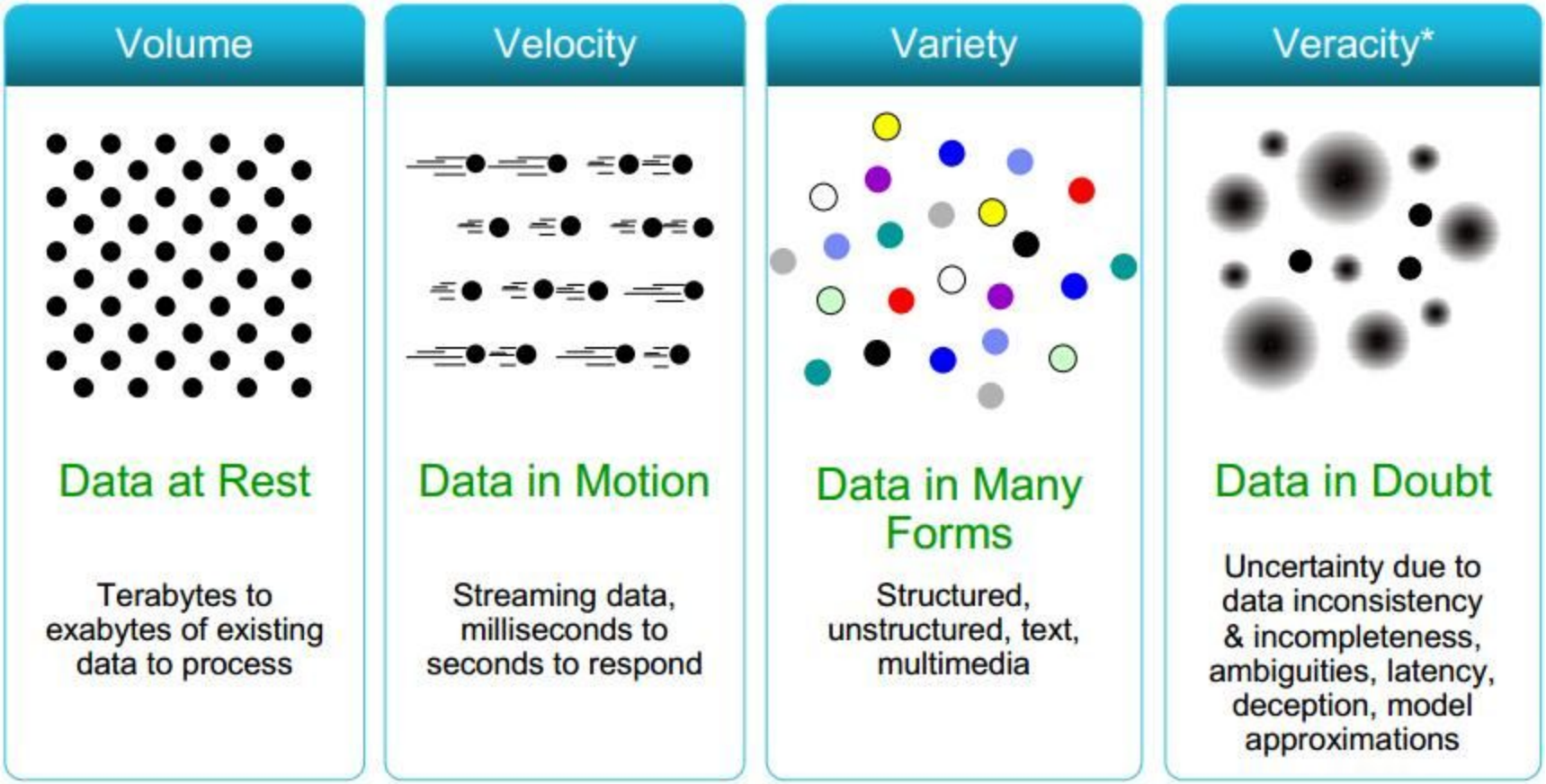


Horizon Report 2018

Agenda

- Definitions of big data, machine learning and artificial intelligence
- New Basics of Complex Systems Research
- AI and the Learning Journey
- Dynamic Learning Analytics for Assessment
- Personal Learning – Collaboration – Problem Solving Framework

Definition: Big Data



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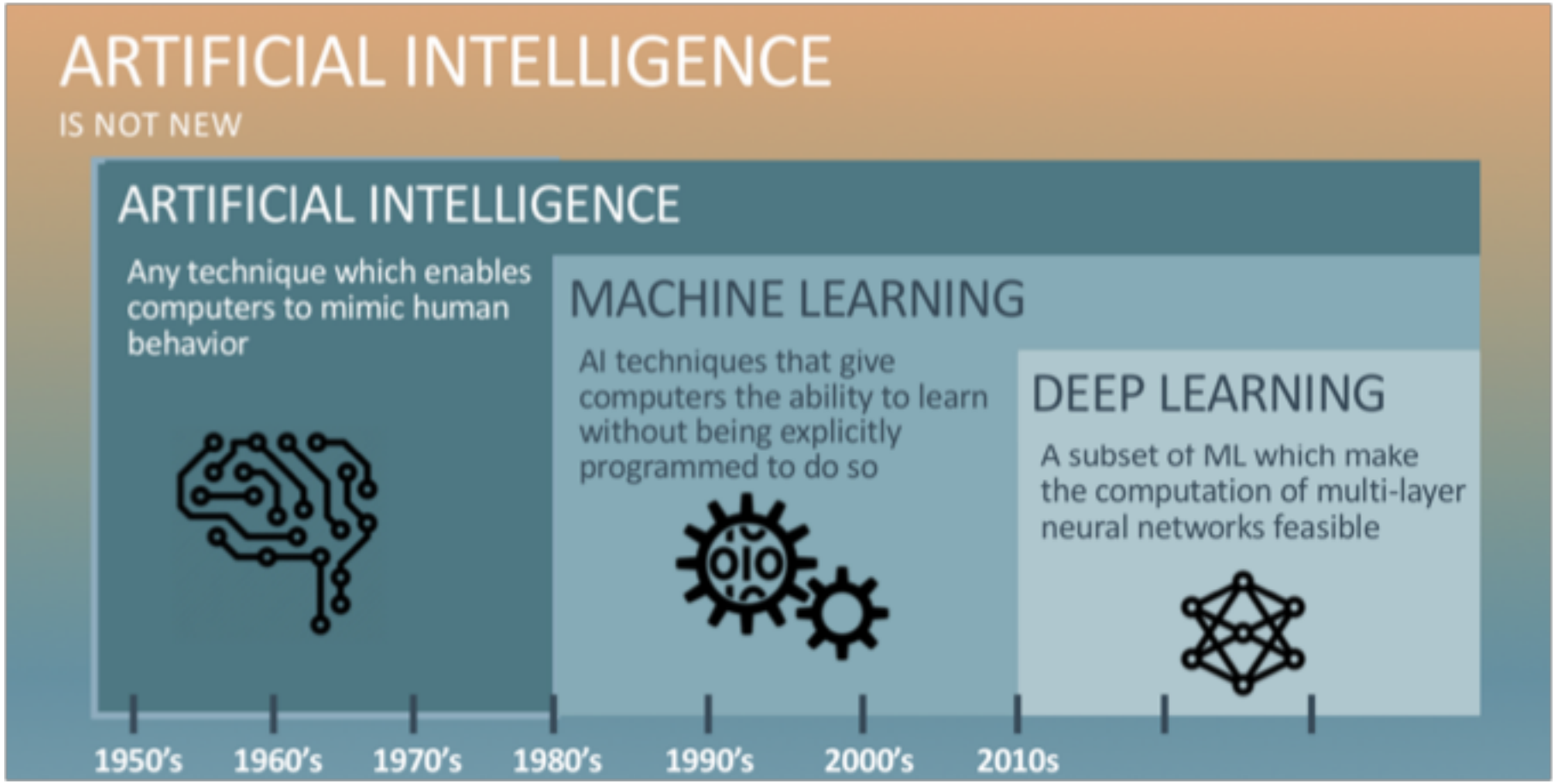
Definition: AI and ML



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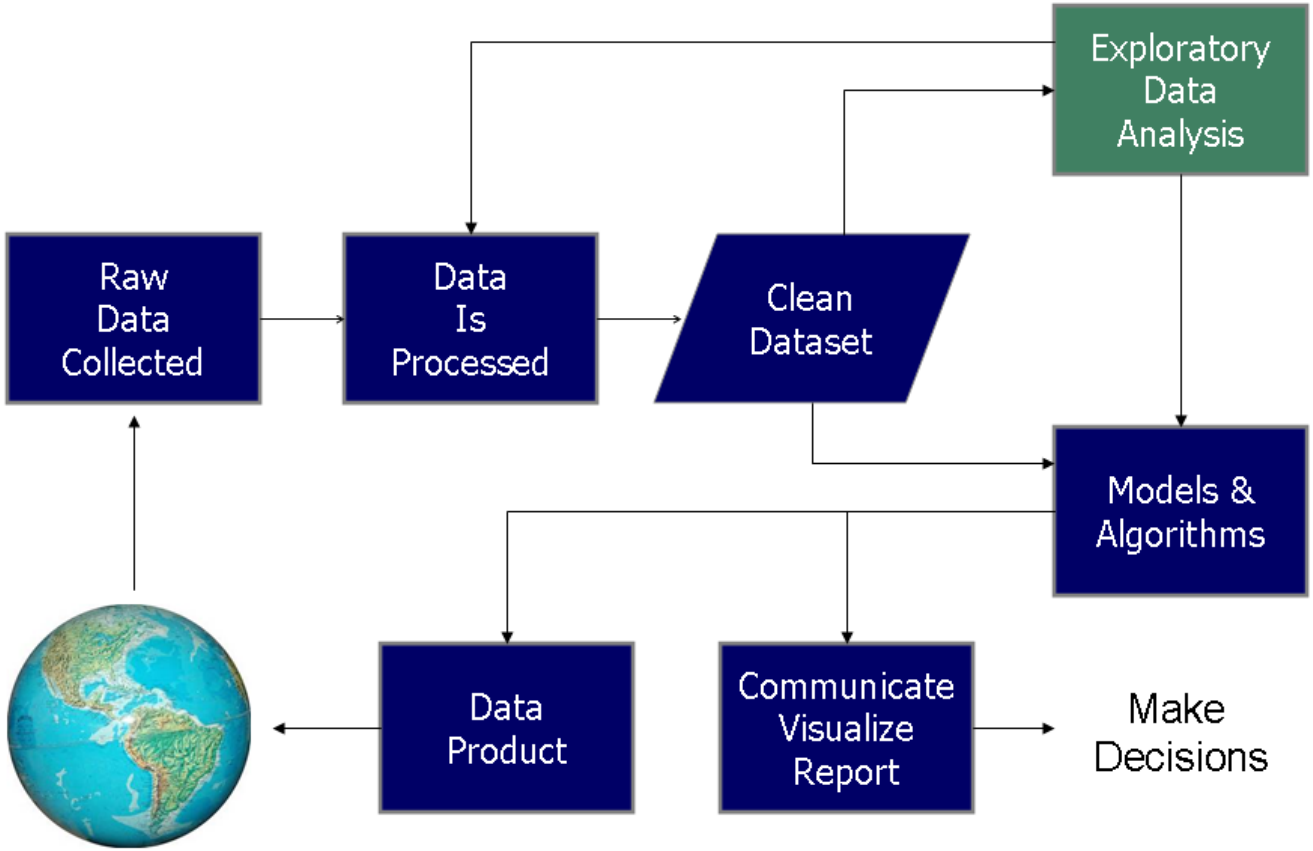
Data Science Process



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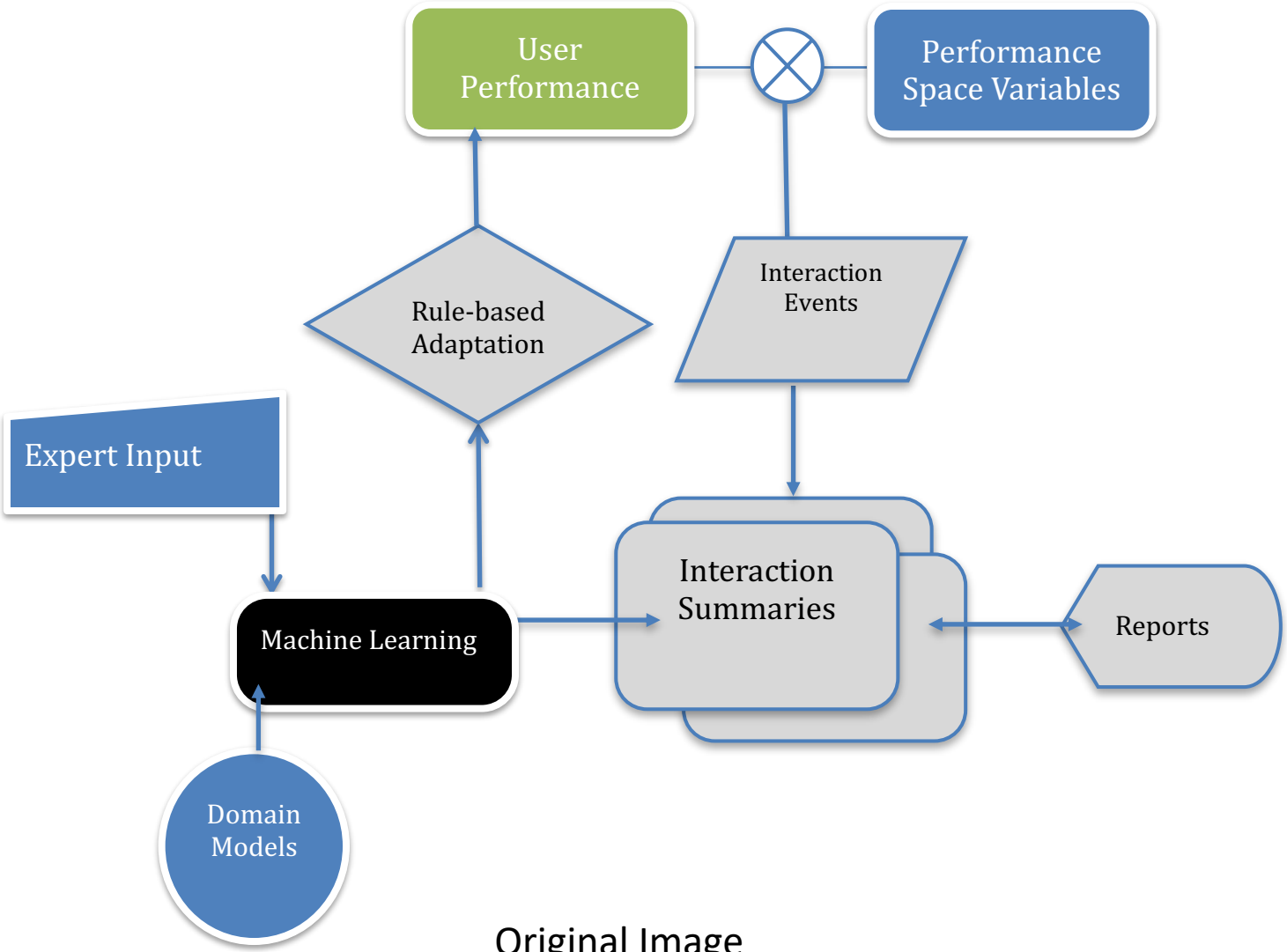
Human-to-Machine Shaping AI in Challenge



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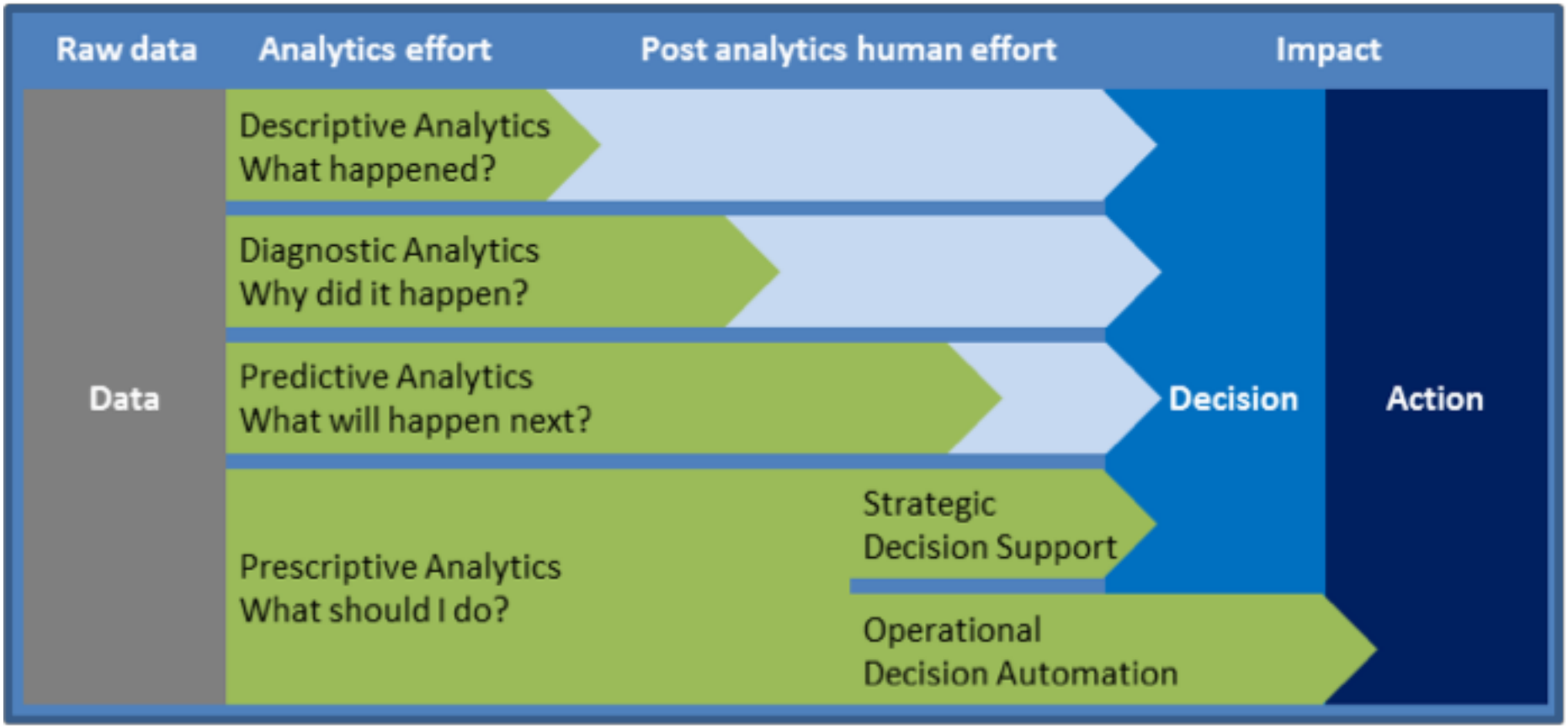
Analytics Target Range



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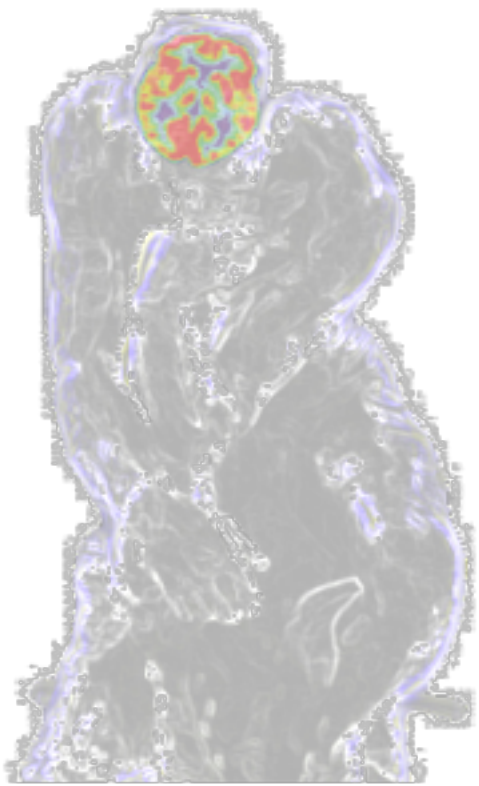
Thinking About Complexity & Six New Basics

- New aspects of reality *emerge* locally from a surrounding and interpenetrating global complexity
- Multifaceted *open ecology:* multiple causes, indirect feedback, nonlinearity and chaos



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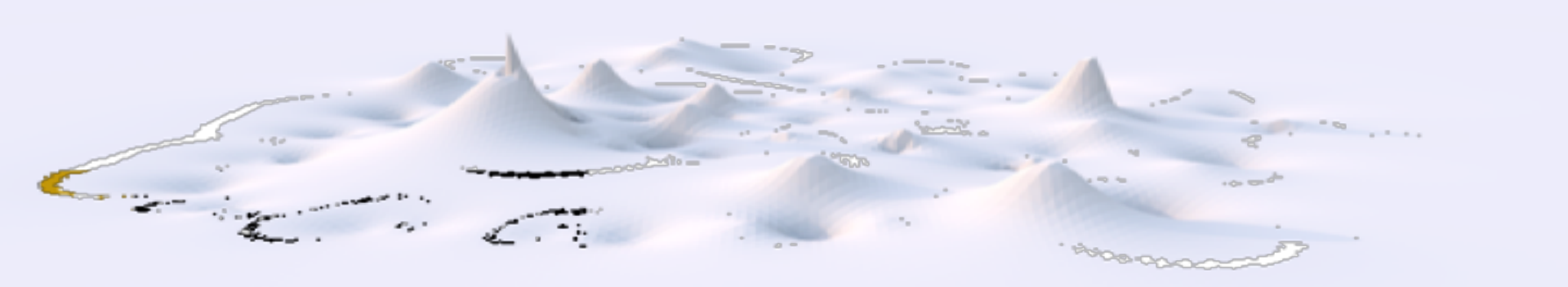
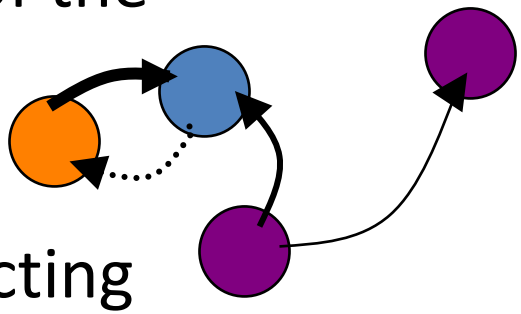
Complex Systems as Transdisciplinary Multidimensional Landscapes

- Time (e.g. historical preconditions, longitudinal data, recurring patterns and autocorrelations)
- Space (e.g. network topologies, neighbor effects, socioeconomic geographies)
- Scale (e.g. neurons to sociopolitical communities)
- Dynamics (e.g. unique behavioral profiles even under highly similar conditions)



New Basics 1 & 2

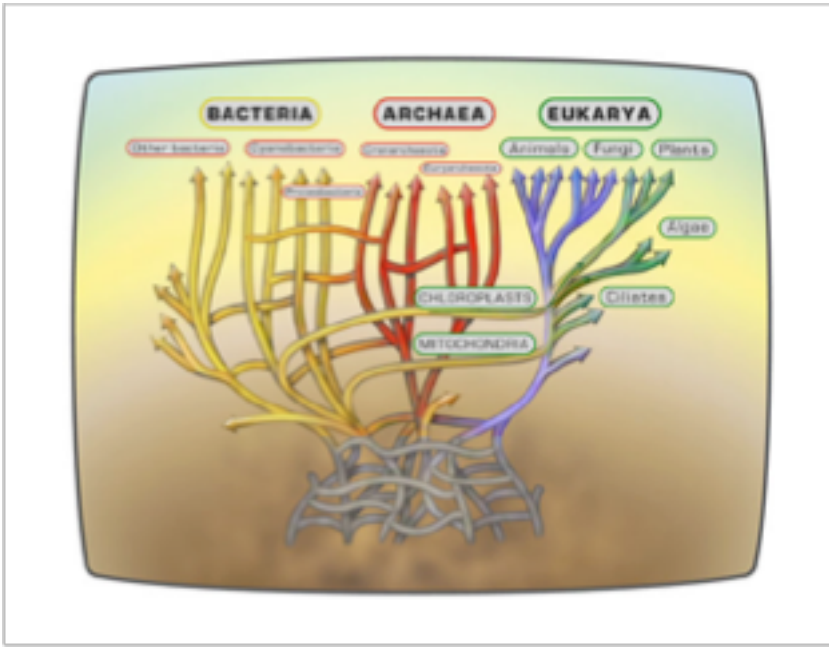
- Nonlinearity
  - *Output is not proportional to input*; the cause of some response by the system is not the simple sum of the stimuli
- Feedback loops
  - *Information is recycled*, connecting the current state to past states of the system



New Basics 3 & 4

- Openness
  - The system *accepts "inputs from" and "outputs to"* a larger external environment
- Memory
  - *Impacts* on the current state of the system *are carried forward* into future states of the system

New Basics 5 & 6



- Nested relationships
  - *Components may themselves be complex*
- Emergent properties
  - Properties of the whole system *need a new level of analysis and representation* from that of the components.

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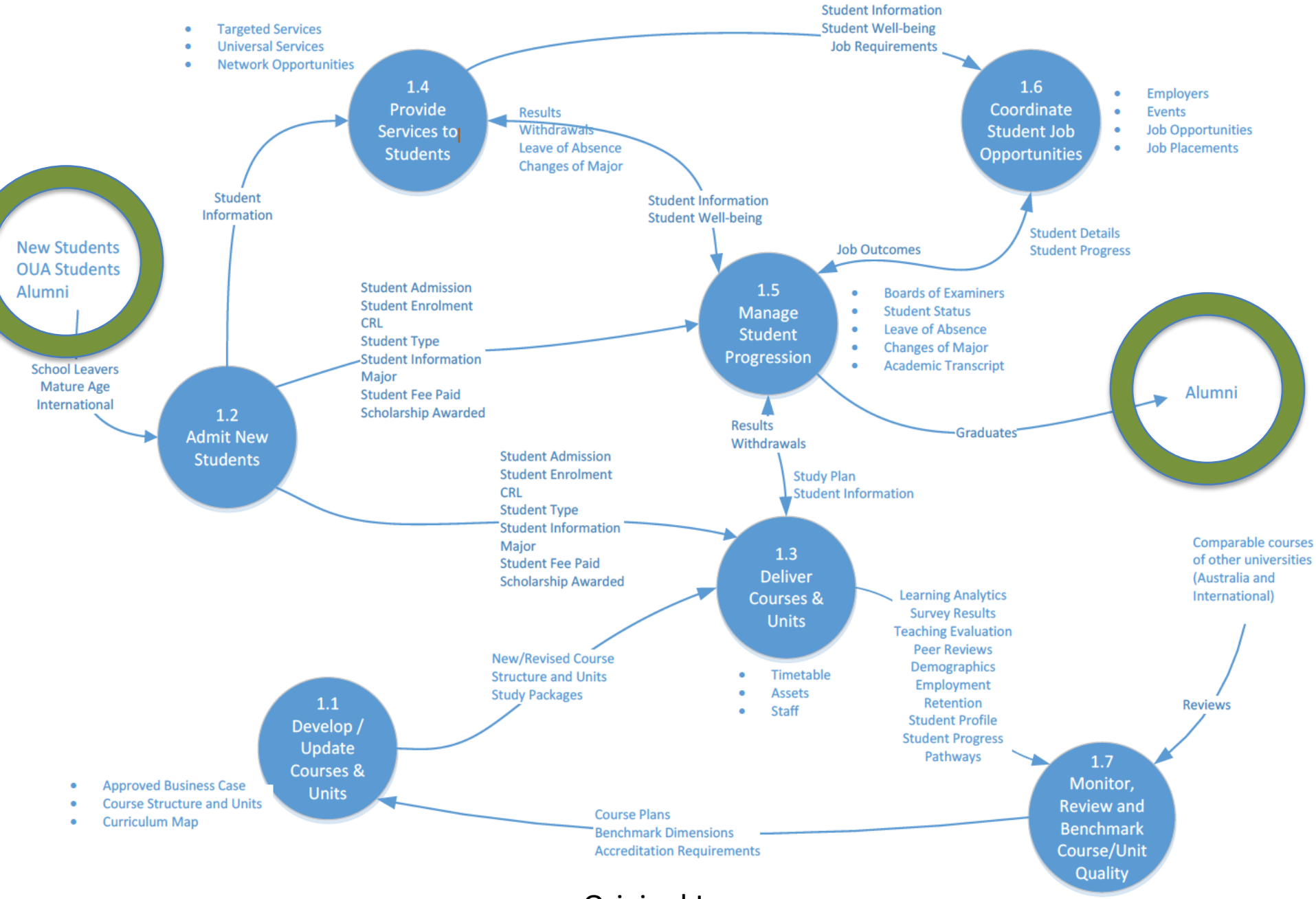

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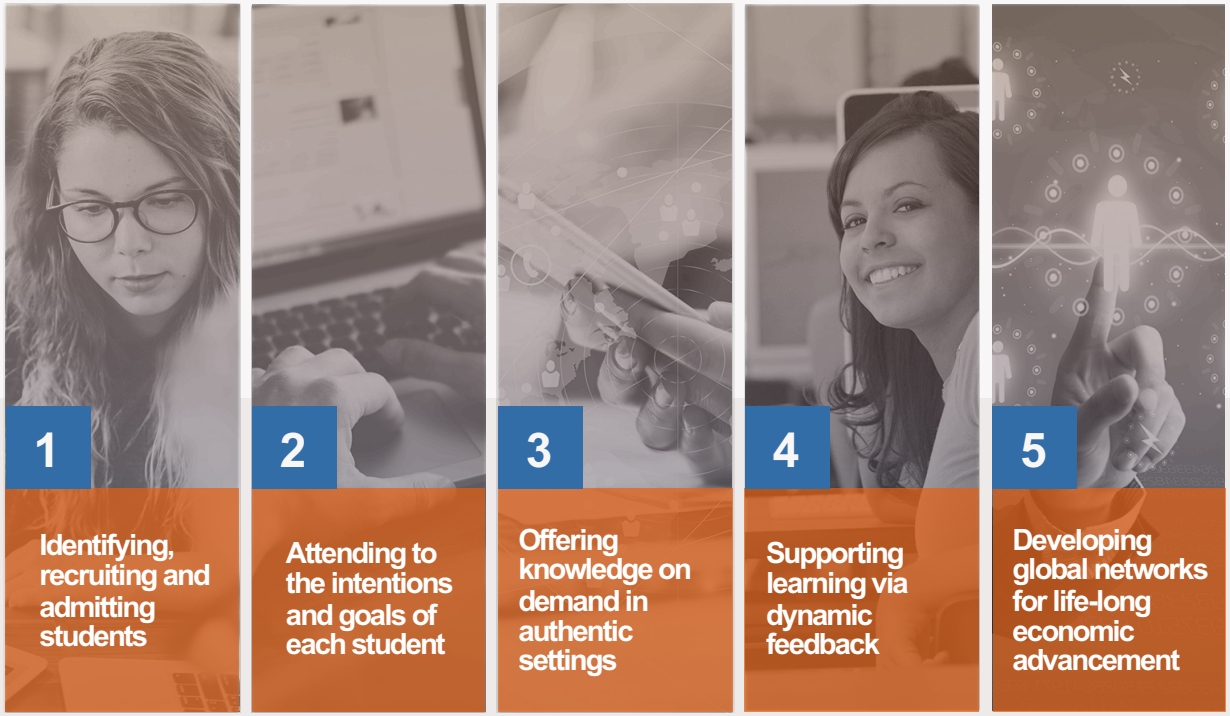
5 Domains of Data Science in Higher Education



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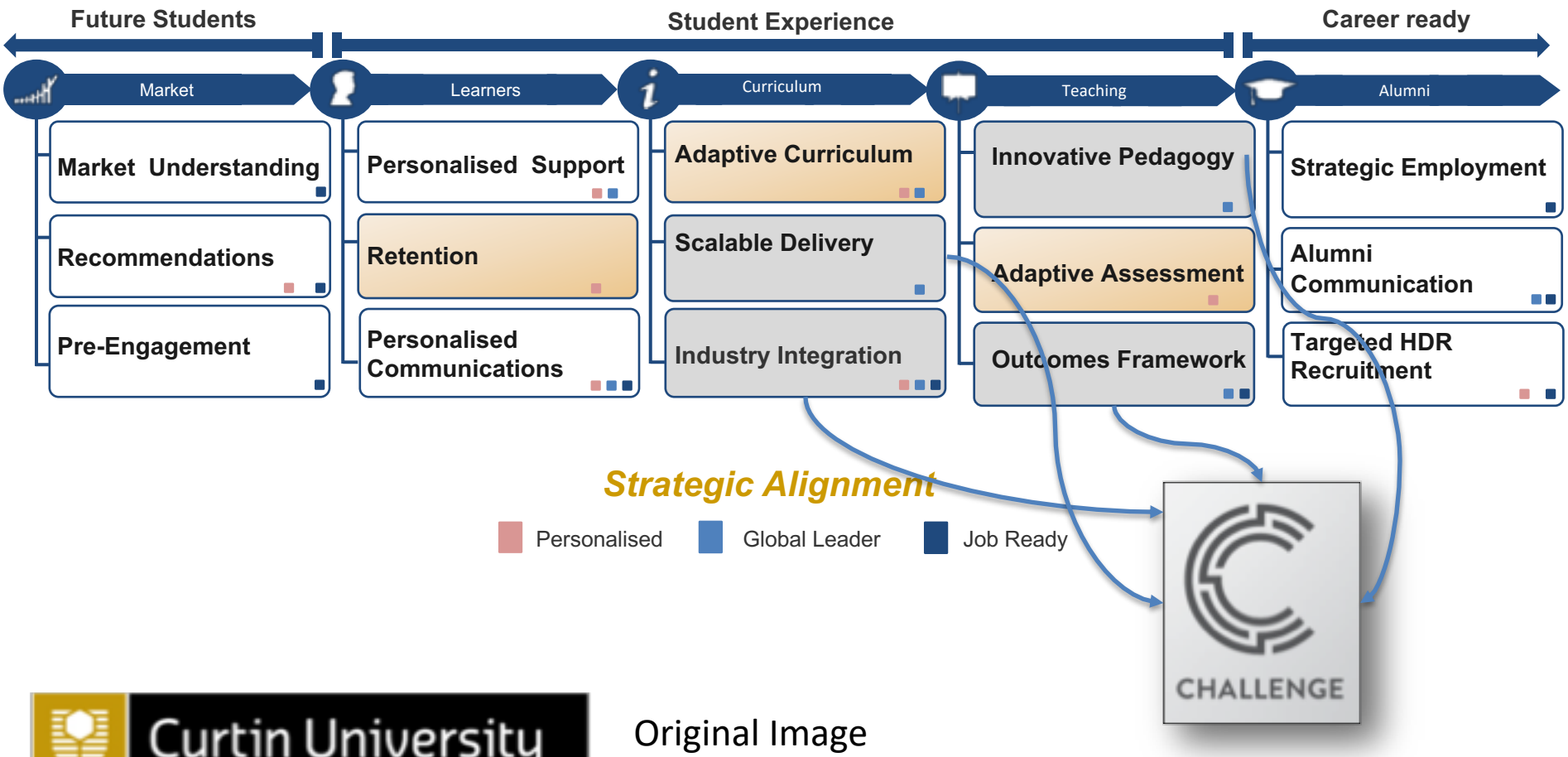
Adaptive, personalised learning supporting a student's journey, executed at a global scale



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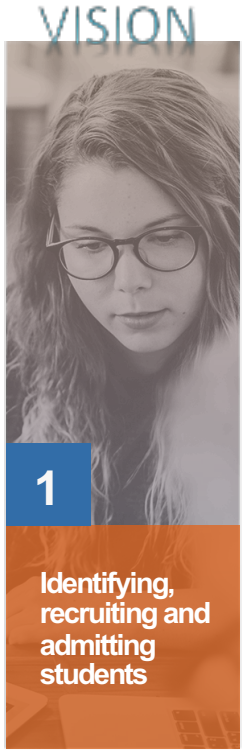
Developing Talent



- **Market Understanding**

Curtin generates profiles of in demand skills in the market, tracks education trends, and reacts accordingly

- **Personalised Recommendations**

Student and market information are used to aid course selection and align student expectations

- **Community Engagement**

Curtin's market knowledge is reflected in its outward facing marketing and community engagement

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Personalization at Scale

- **Personalised Support**

Support services use interaction history to learn from interaction and become tailored to individuals

- **Proactive Retention Management**

Students with high attrition risk are identified early and receive targeted preventative interventions.

- **Personalised Communication**

Learning materials are targeted at students based on learning progress and their intentions

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Emergent Curriculum

- **Adaptive Curriculum**

Curricula are dynamic, adapting in real time to student needs and the external environment

- **Scalable Delivery**

The latest technologies deliver content to all students & staff and allow near-real time feedback and decisions

- **Integration with Industry**

Curricula are designed to deliver the competencies in demand and allow relevant work place learning

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Dynamic Delivery

- **World Leading Pedagogy**

Analytical research into student cognition and teaching method are used to define Curtin's practices, and drive student self-awareness

- **Adaptive Assessment**

Student evidence of learning is measured continuously, allowing targeted, dynamic assessment

- **Managed Outcomes Framework**

Students are assessed against a granular framework, allowing for an iterative approach to learning

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Global Networks

- **Strategic Employment**

Market analysis and an unique assessment framework allow students to secure positions with high prestige employers

- **Alumni Communication**

Alumni are engaged with information on market and industry trends and opportunities for further study

- **Targeted Recruitment into Research**

Engagement in research is developed from specific analysis of history and student competency

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Challenge Based Learning

- Self-directed learning and social collaboration
- Promoted through problem based learning
- In a technology-enabled and game-based learning environment

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Measurement Targets

- Understanding big ideas - systems knowledge
- Dealing with time and scale
- Practice in decision-making
- Active problem-solving
- Concepts, strategies, & tactics
- Understanding processes beyond experience
- Practice & improvement over time

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Assessment Plan

- CONTEXT
  - Observations of group members
  - *Designed domain-task-performance space*
  - Coordinated activity to construct and maintain a shared conception of an open-ended problem
  - Achieve some goal
- 3 KINDS OF MEASURES (learner inputs)
  - *Actions, Communications, Products*
- RESULTS
  - Evidence of higher order creative, critical thinking and communication skills

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Interaction Traces = Evidence

- New *frameworks, concepts* and *methods* are needed for measuring what someone knows and can do based on game interactions and artifacts created during serious play

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Interaction Traces = Evidence

- Interactions and artifact creation processes create *streaming data traces that provide evidence of performance and learning*

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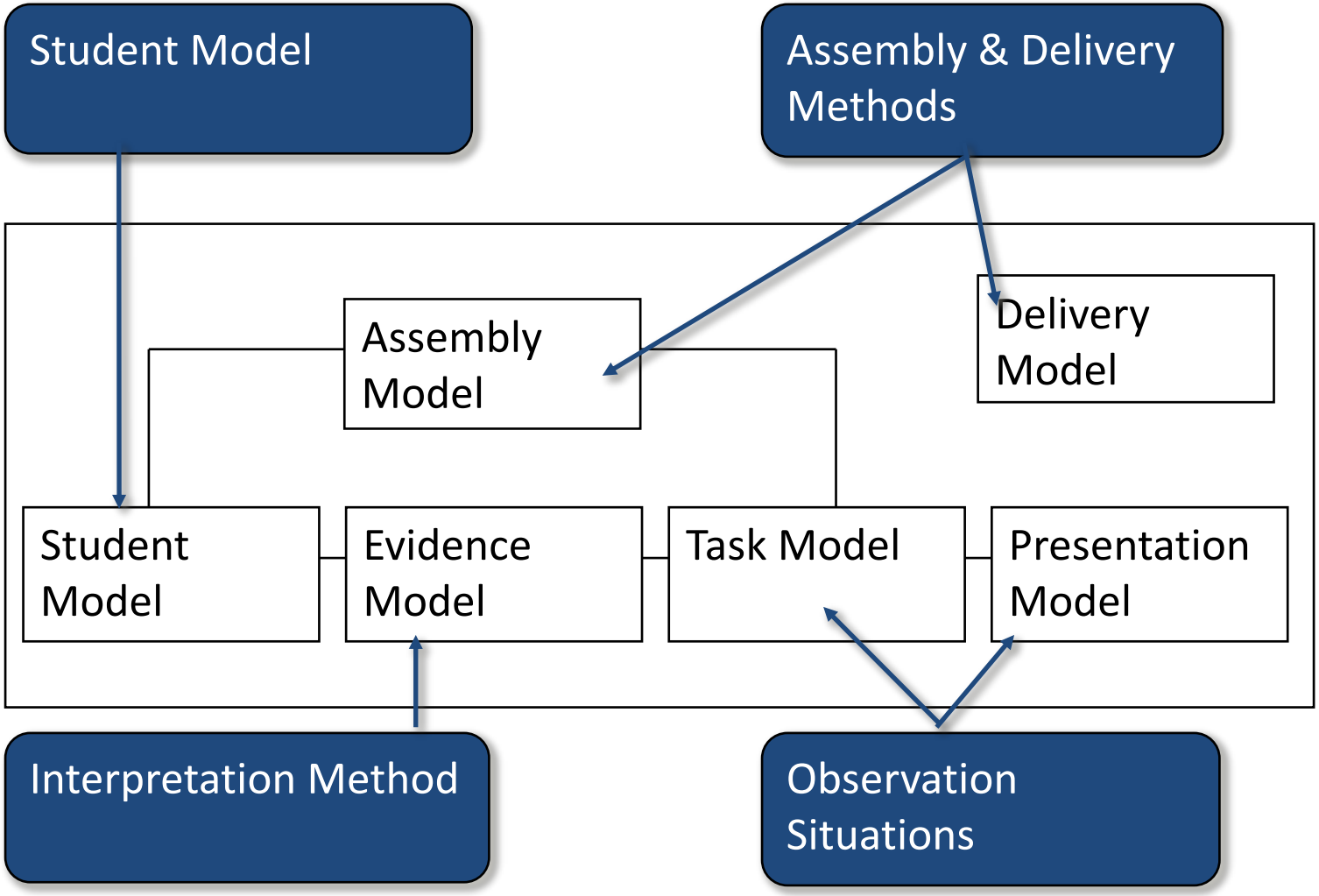
Evidence Centered Design



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Adapted from (Mislevy, Steinberg, Almond)

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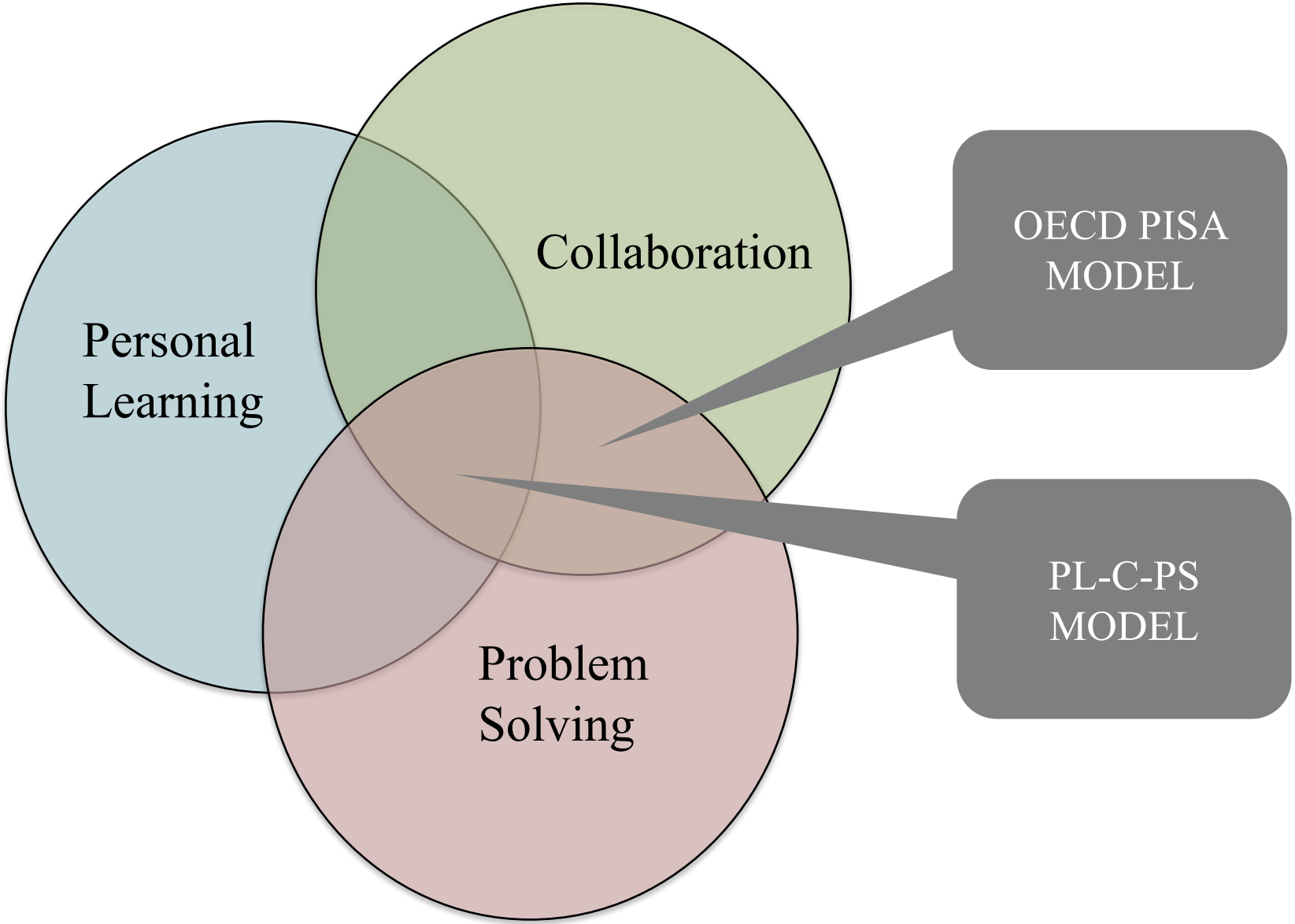

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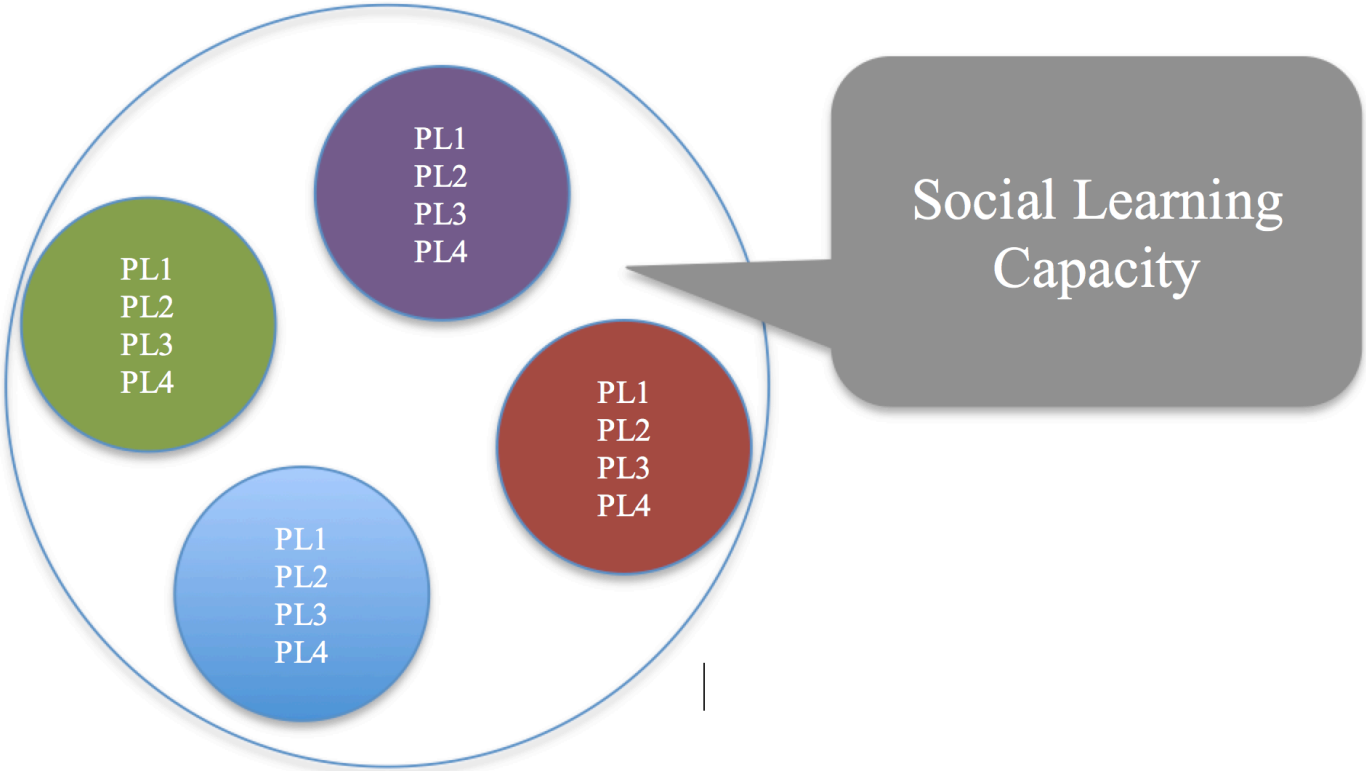
PL-C-PS Domain Model

- **Personal learning:** acquisition of knowledge (e.g. new insights, capacities for thinking, acting and employing skills) that is evidenced for outside observers as well as an individual's own reflection and metacognition.
- **Collaboration**: coordinated group activity resulting from continuous attempts to construct and maintain a shared conception of a problem (Roschelle & Teasley, 1995)
- **Problem solving:** cognitive processing directed at achieving a goal when no solution method is obvious (Mayer & Wittrock, 1996).

Design Process Questions

Personal Learning
1. How can the learner share their background, experience and initial thoughts? 2. How can the learner be exposed to and reconcile differing ideas and viewpoints? 3. How can the learner create a critically reflective response-artifact that articulates a new understanding at this point in time? 4. How can the learner communicate and celebrate the results thus far?
Collaboration
1. How can the learner establish and maintain the group's shared understanding of the problem? 2. How can the learner take appropriate action to solve the problem? 3. How can the learner help establish and maintain the team organization?
Problem Solving
1. How can the learner explore and understand the problem? 2. How can the learner represent and formulate solution options? 3. How can the learner plan and execute appropriate actions? 4. How can the learner monitor and reflect on progress?

Social Learning Group Capacity



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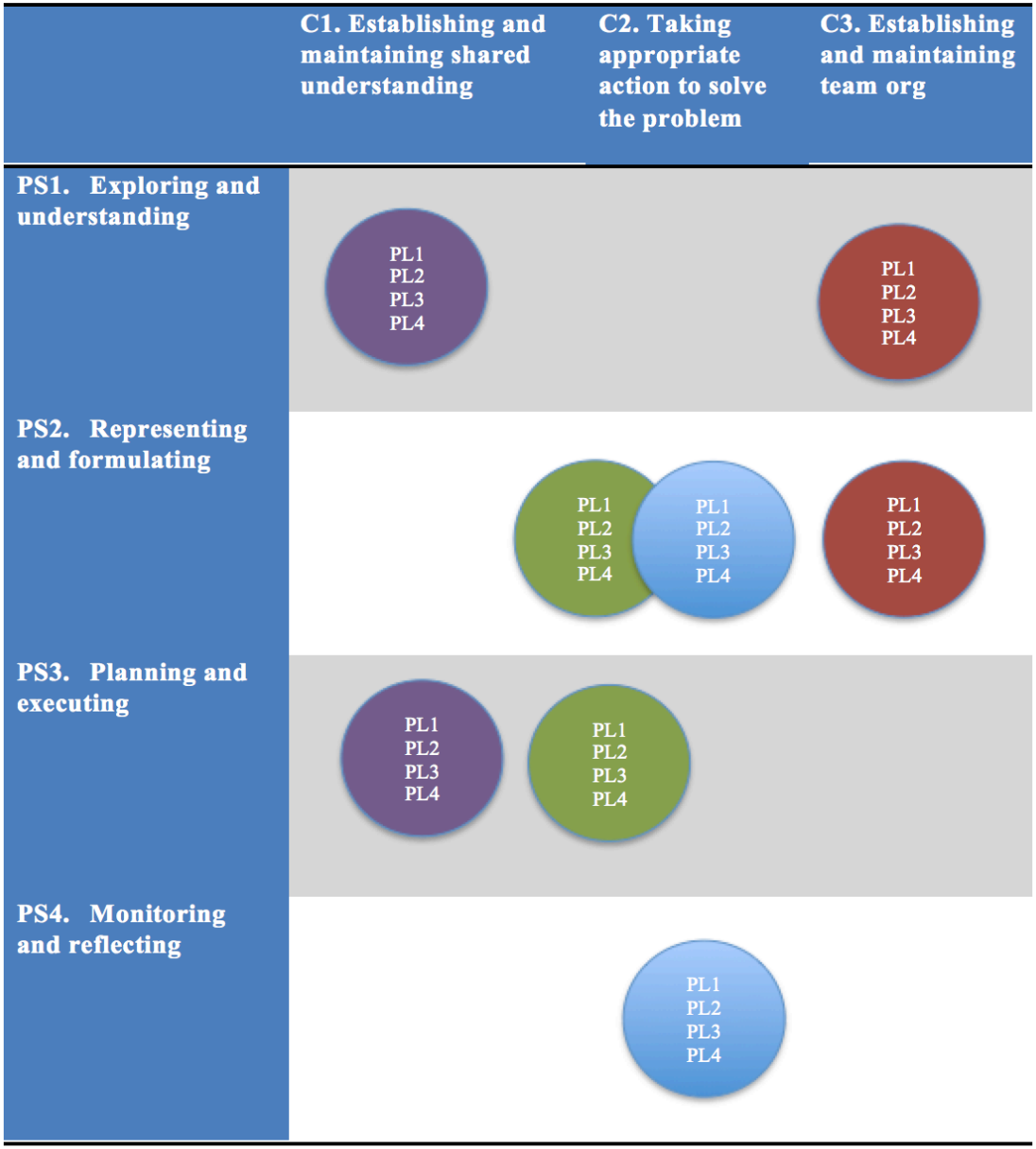

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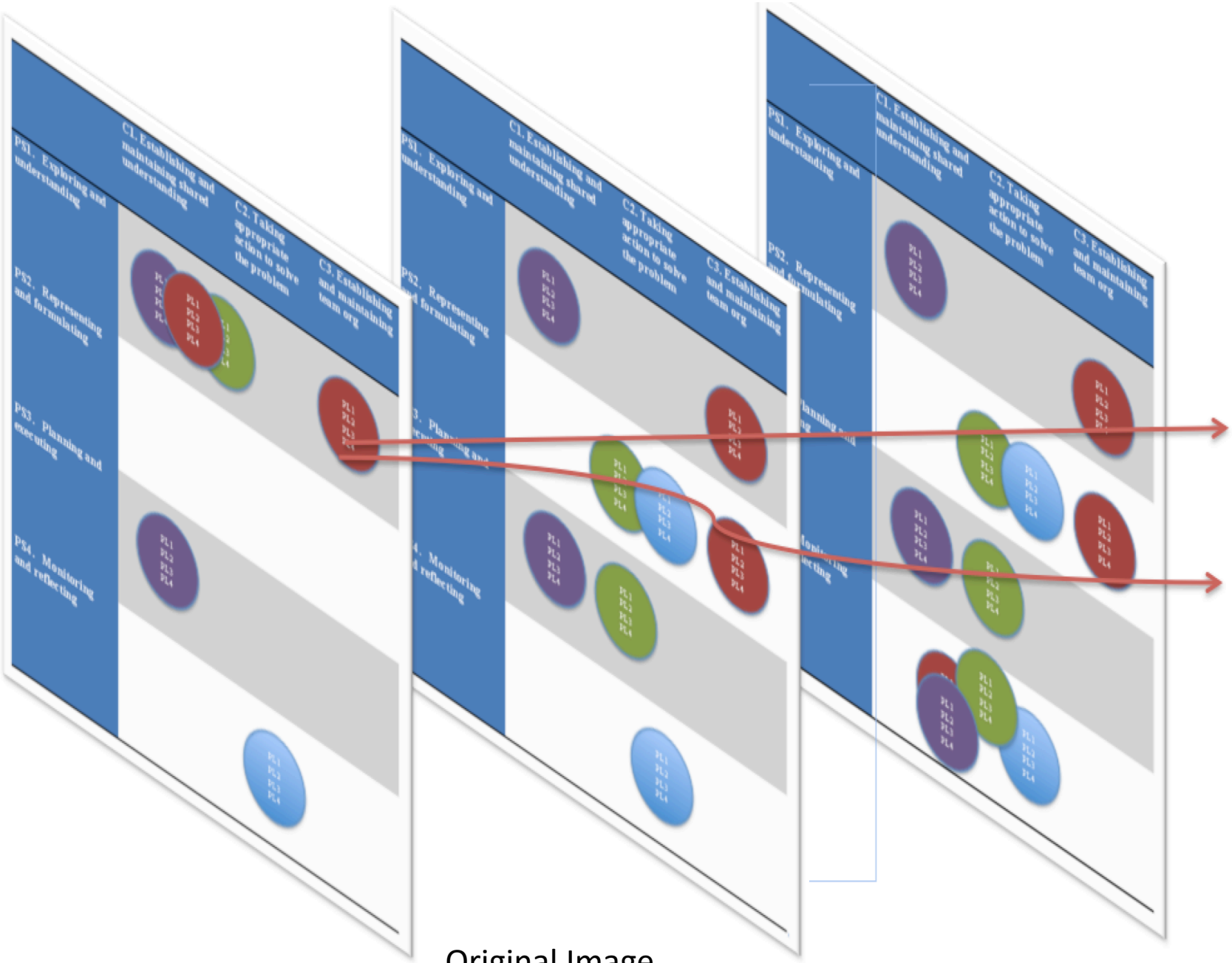
OECD Assessment Framework for Collaborative Problem Solving

…as a theater for individual action during online collaborative problem solving



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Closing Remarks

Big Data & The Learning Journey

- Requires educational researchers, practitioners and policymakers to understand how insights can be gained from the use of new tools and approaches to learning, teaching, evaluation and research.

Eliciting High-Level Skills

- The rise of smart technologies is the foundation for several emergent challenges and opportunities for eliciting and validating the acquisition of high-level skills such as collaboration, creativity, critical thinking and communication.

Capacities for Learning Futures

- Create innovative content and delivery modes
- Provide personalized education at scale for the global education marketplace
- Continuously harvest analytics insights to improve learning and teaching, the student experience, and the enterprise.

Contact Information

Professor David Gibson

Director Learning Futures

UNESCO Chair of Data Science in Higher Education Learning & Teaching

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david.c.gibson@curtin.edu.au