

Building a Competency Model from a Learning Record Store Just Prior to New Learning Experiences

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Thank you to my contributing authors...

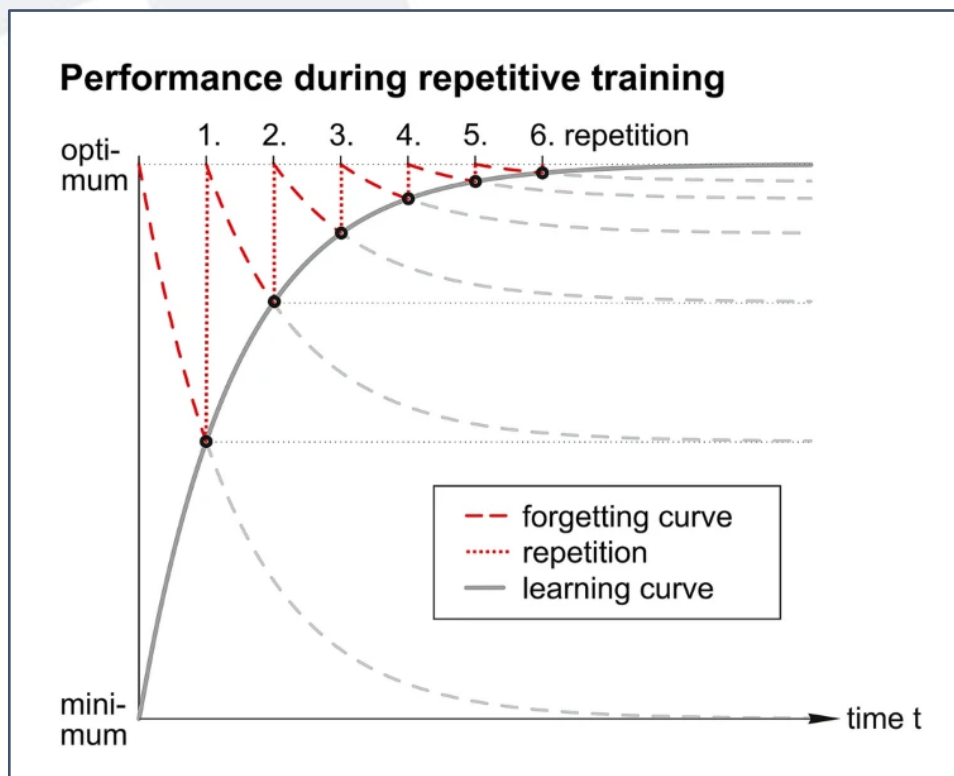
- Amanda Bond
- Hank Phillips
- J.T. Folsom-Kovarik
- This presentation updates a previous analysis:
 - Sottolare, R. A., Long, R. A., & Goldberg, B. S. (2017, April). Enhancing the Experience Application Program Interface (xAPI) to improve domain competency modeling for adaptive instruction. In Proceedings of the Fourth (2017) ACM Conference on Learning@ Scale (pp. 265-268).

Assessing the Problem

- Building a competency model...
 - what tasks, roles and skills make up the training activity?
 - what generic work skills (or foundational skills) are required?
 - what knowledge is required to perform the training activity?
 - what evidence does the learner need to demonstrate to be considered competent in the training activity?
- ... from information in an LRS (list of achievement (xAPI) statements)
 - is there sufficient information in the LRS to answer the questions above?
- ... just in time to support a new learning experience.
 - is it evident from the information in the LRS that the learner is competent in the training domain?

What is competency?

- The ability to do something successfully or efficiently (Oxford English Dictionary)
 - “do” = perform
 - “do something” = tasks, functions, actions (e.g., behaviors)
 - “successfully” indicates “something is measured” (e.g., accuracy)
 - “efficiently” indicates that the something that is measured is **time**



Kunert, W., Storz, P., Dietz, N. et al. Learning curves, potential and speed in training of laparoscopic skills: a randomised comparative study in a box trainer. Surg Endosc 35, 3303–3312 (2021). <https://doi.org/10.1007/s00464-020-07768-1>

What is competency?

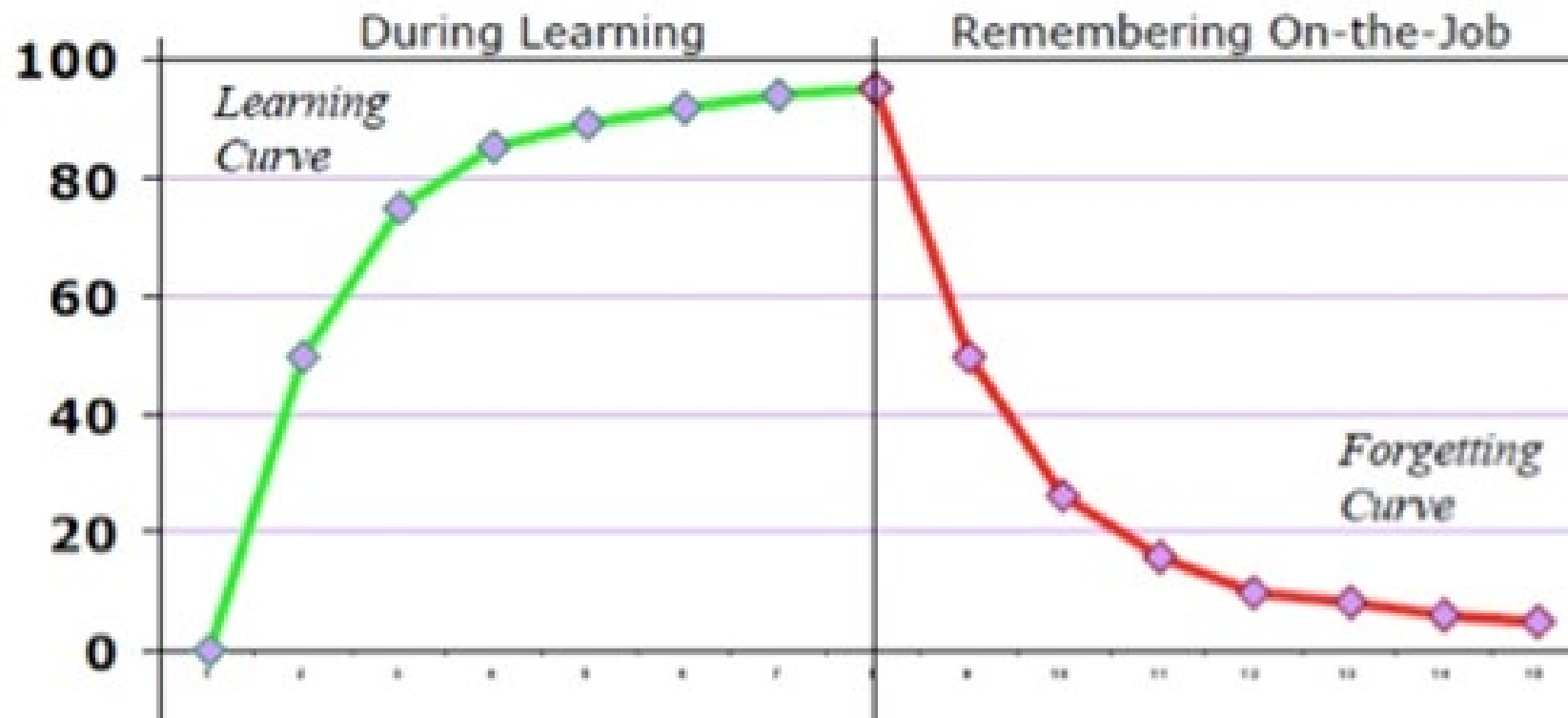
- Differences between competency and proficiency
 - both pertain to the application of learned skills to perform a task
 - competency - refers to the essential skills required
 - proficiency implies a level of mastery of these essential skills



COMPETENCIES	SKILLS
Competencies are the skills, knowledge, and abilities that make you successful in a job	Skills are the learned abilities you need in order to complete a specific task
Indicate how a task is performed effectively and successfully	Indicate what type of talents or abilities an individual needs in order to complete a specific task
Ex: Problem-solving, negotiating, and strategic planning are some examples of competencies	Ex: Handling accounts, computer programming, and writing tenders are skills you can learn in a job

What is competency?

- Building and maintaining competency
 - Spacing and repetition to support learning and remembering



Thalheimer, W. (2006). Spacing learning events over time: What the research says. Retrieved from <http://www.work-learning.com/catalog/>.

Rationale for modeling competency

- Differing levels of learner experience should be considered when selecting an appropriate user-adapted instructional design (Kalyuga, Chandler & Sweller, 2000)
- To guide adaptive instructional system (AIS) design and multimedia course design through the selection of content (e.g., diagrams, audio, or text) and management of each learner's cognitive load (Kalyuga, Chandler & Sweller, 2000)
- To determine course flow, evaluate options to skip course lessons, and select strategies to optimize the learning experience (Sottolare, Long & Goldberg, 2017)
- To build a longitudinal element (beyond performance) into learner or team modeling

Kalyuga, S., Chandler, P., & Sweller, J. (2000). Incorporating learner experience into the design of multimedia instruction. *Journal of educational psychology*, 92(1), 126.

Sottolare, R. A., Long, R. A., & Goldberg, B. S. (2017, April). Enhancing the Experience Application Program Interface (xAPI) to improve domain competency modeling for adaptive instruction. In Proceedings of the Fourth (2017) ACM Conference on Learning@ Scale (pp. 265-268).

Recording Competencies as Achievements

- **Actor:** an individual or a group that does something. An actor is required for each xAPI statement. In the statement, “Bob completed the algebra course”, “Bob” is the actor.
- **Verb:** identify the actions of the actor(s). In the statement, “Rodney created a webpage”, created is the verb.
- **Object:** is the thing that is acted upon by the actor. The object can be an activity, agent or group, or a sub-statement. In the statement, “Ben completed the boating course”, the object is “boating course” (an activity).
- **Result:** a measured outcome (completion, success, response or duration). Results are optional. In the statement “Bob scored 92% on the final exam”, the result is “92% on the final exam.”
- **Context:** the conditions under which the activities took place. Context is optional. In the statement “Rodney and Ben completed a flying lesson in rainy conditions”, the context is “rainy conditions.”

It is not enough to complete a learning experience...

What was recommended 5 years ago to enhance xAPI statements...

- **Document contact time** – Bob completed a four hour course on quadratic equations
- **Document the quality of sources** – rate experience effectiveness of learner population over time (ala journal impact factors)
- **Document the quality of the experience** – enable sources to rate the efficiency and content coverage of each learner's experience along with their assessment of performance
- **Document learning and forgetting curves** – identify where learners are situated with respect to learning and forgetting, and recommend refresher experiences
- **Document assessments** - model the nature and quality of learner knowledge and skills
- **Evaluate the effect of instructional decisions** - data analytic capabilities should continuously evaluate the effect of instructional decisions on the learner population

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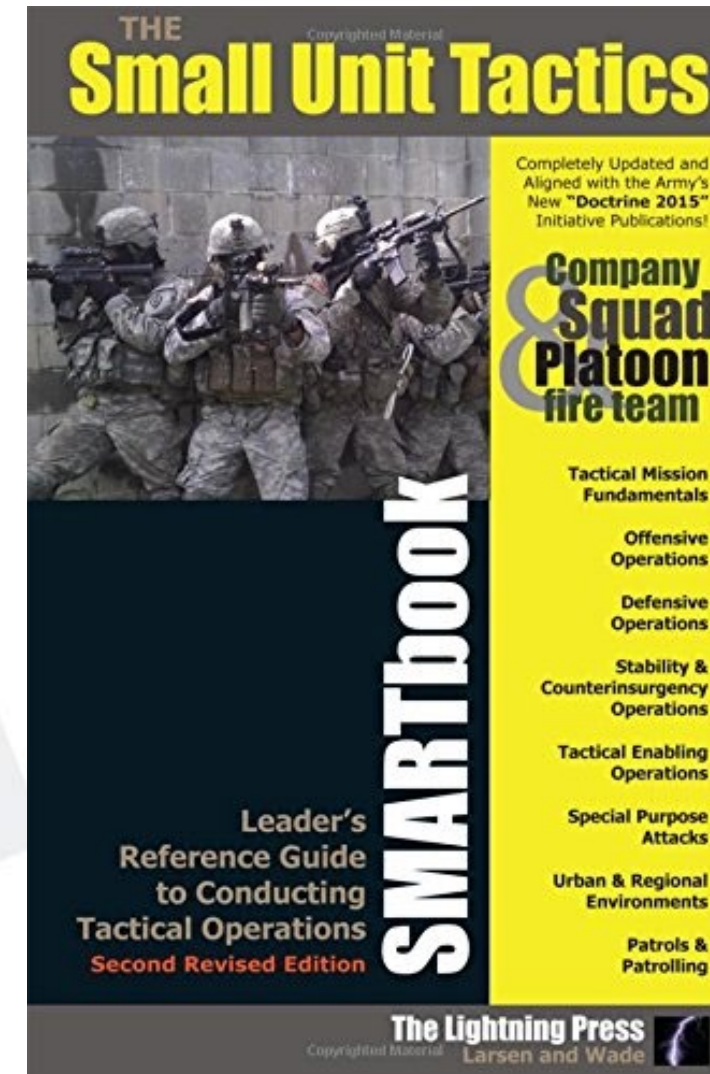
Competency models should be about more than achievements

Competency models should evaluate skill proficiency

- **Task skills** – ability to perform a task(s)
- **Task management skills** - ability to manage a range of tasks to complete work requirements: prioritizing, integrating, planning, and organizing tasks
- **Interpersonal or teamwork skills** – ability to work with others toward common goals
- **Contingency management skills** – ability to respond effectively to unplanned events
- **Job management skills** – ability to manage the roles and responsibilities associated with a job with an organization
- **Transfer skills** – ability to read, interpret, and contextualize competency standards
 - where were skills applied (operations or training context)?
 - how were skills evaluated?
 - what evidence was used to confirm learning and performance?
 - under what conditions were tasks conducted?

Competency models should identify trends

- **Individual learning trends** – longitudinal information about the learning experiences of individual learners and their job readiness
- **Team trends** – longitudinal information about the learning experiences of individual members of teams and the previous learning history of persistent teams
- **Population trends** – longitudinal information about the learning experiences of everyone in a domain of instruction that can be used to improve future experiences and identify individuals based on job readiness

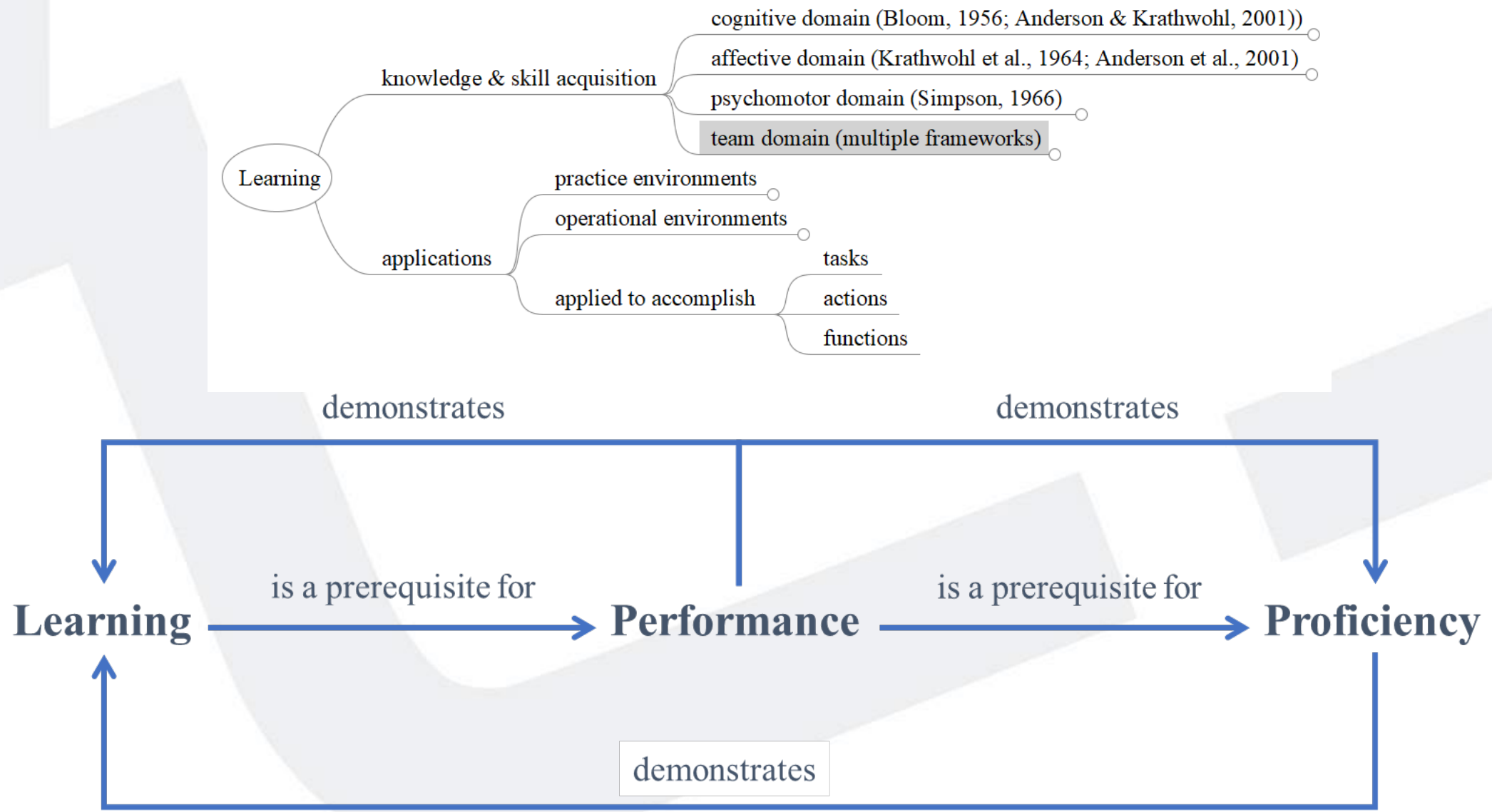


What needs to be in an LRS to support JIT competency modeling?

Just-in-Time Competency Modeling Insights

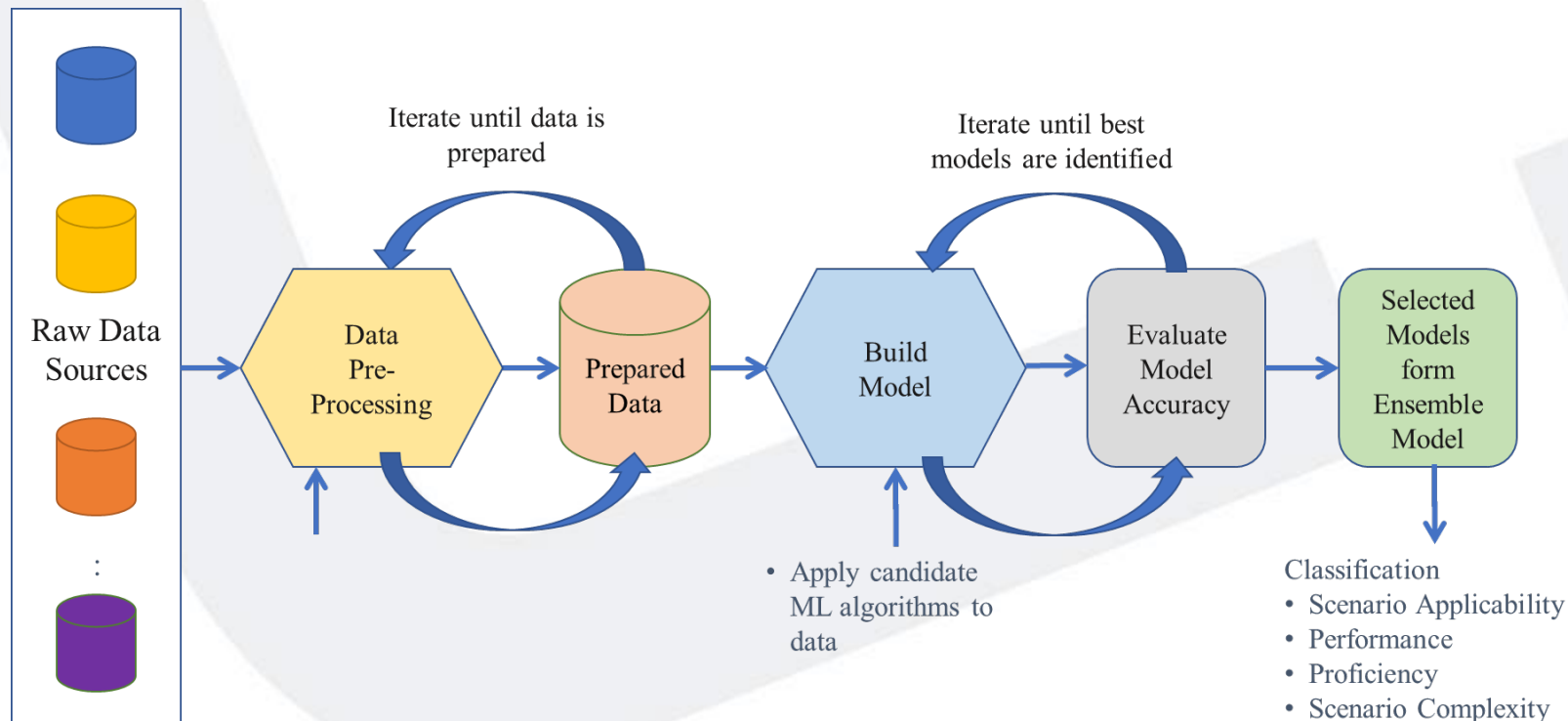
- We model competency to support tailoring decisions during adaptive instruction
- Competency modeling for individual learners is a complex process
- Competency modeling for teams is more complex
- Just-in-time competency modeling for teams is another level of difficulty
- Competency modeling should include:
 - individual, team and population achievements
 - skills proficiency models
 - individual, team and populations trends
 - any data that can classify/predict or influence learning

Just-in-Time Competency Modeling Insights



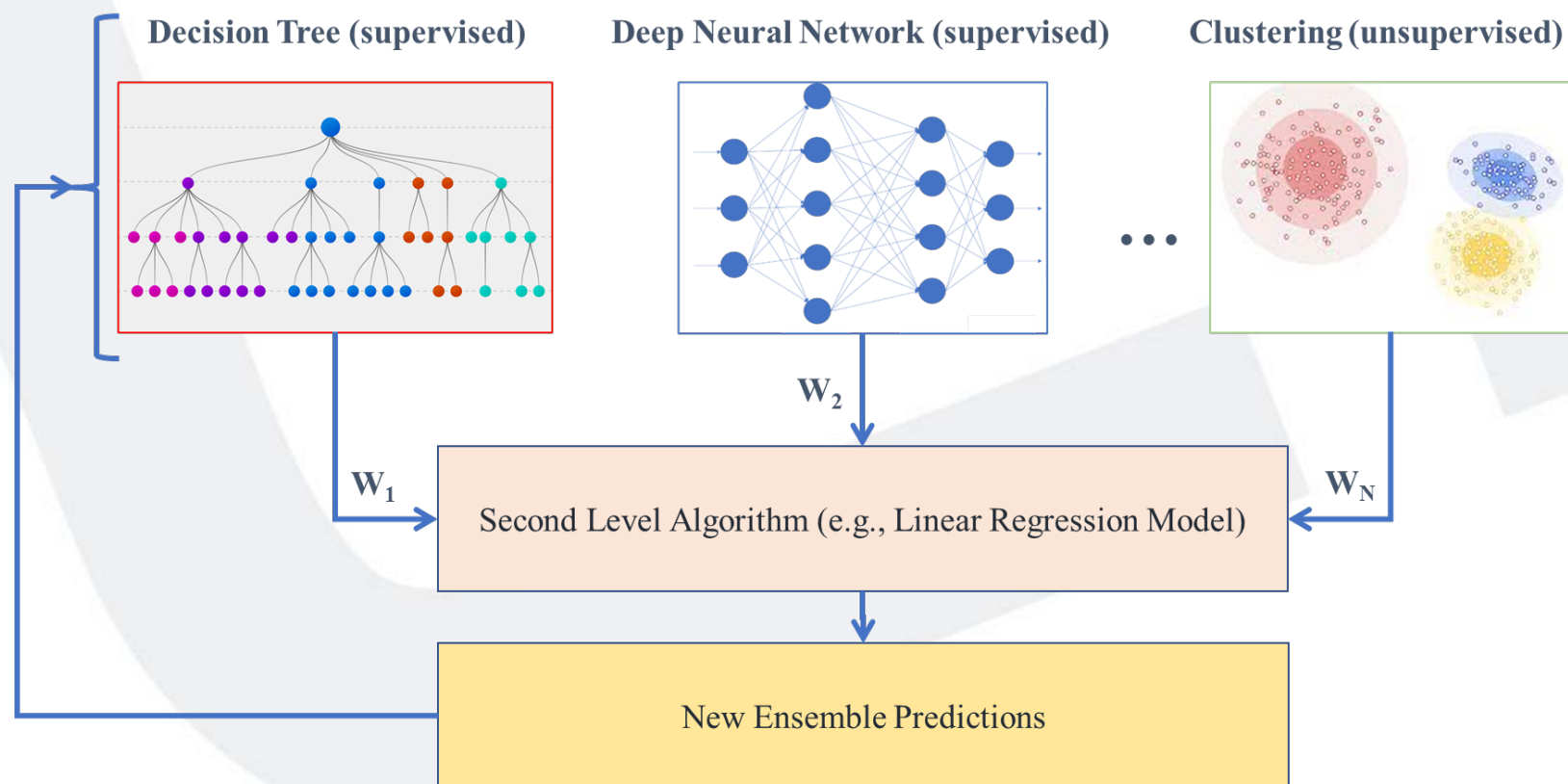
Just-in-Time Competency Modeling Insights

- Accurate, just-in-time competency modeling requires:
 - Data stream mining and data enrichment processes
 - Feature engineering processes
 - Machine learning (ML) algorithms to support competency model development
 - Methods to assess the accuracy of candidate ML models and select the best



Just-in-Time Competency Modeling Insights

- Develop a DoD community-based ensemble model to assess foundational competencies:
 - teamwork and leadership skills
 - military decision-making skills
 - critical thinking skills



Thank you for your attention...

Questions...

email me at... bob.sottolare@soartech.com