1. **Research Title:** Creation of Materials, Manufacturing and Design Knowledge Representation via Self-assembly of Ontology Design Patterns

2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Data Science/Knowledge Representation (MS or PhD)
4. **Objectives:** The technical objectives of this topic are to (1) develop, and locally employ self-assembling Ontology Design Patterns (ODP) based on context elicited from user actions in manufacturing, (2) develop software agents to retrieve, discover, and predict contextually relevant information.

5. **Description:** Semantic technology (ST) uses formal logics captured in a directed, labeled graph that serves as a knowledge representation of a process or concept. Knowledge graphs require new techniques for integration with machine learning approaches. Traditional machine learningalgorithms take as input a feature vector, which represents an object in terms of numeric or categorical attributes. The main learning task is to learn a mapping from this feature vector to an output prediction of some form, e.g. labels, a regression score, or an unsupervised cluster id or latent vector (embedding). In Statistical Relational Learning (SRL) of graphs, the representation of an object can contain its relationships to other objects through the graph's nodes (entities) and labelled edges (relationships between entities). The main goals of SRL include prediction of missing edges, prediction of properties of nodes, and clustering nodes based on their connectivity patterns. These tasks arise in many settings such as analysis of social networks and biological pathways, but could also be used to describe manufacturing methods (**e.**g., additive manufacturing, ceramic matric composites, or to generalize robotic assembly). [1,2,3], In this activity, we seek to develop knowledge graphs for manufacturing technologies that adapt ST approaches and employ statistical relational learning approaches. Additionally, proposed approaches must explore methods for adapting time -variant data, which are commonin manufacturing. By associating the context inherent in user activity (i.e. running a program to model the curing of a polymeric matrix composite or searching for properties of titanium), the relevant ODPs could be identified, assembled, and utilized to predict knowledge gaps, develop processing approaches for new materials, and digitize subject matter expertise.

6. **Research Classification/Restrictions:** This research has no ITAR restrictions.

7. **Eligible Research Institutions:** All eligible institutions.

References:

L. Getoor and B. Taskar, Eds., Introduction to Statistical Relational Learning. MIT Press, 2007.
Yu, T., Finn, C., Xie, A., Dasari, S., Zhang, T., Abbeel, P., & Levine, S. (2018}. One-Shot Imitation from Observing Humans via Domain-Adaptive Meta-Learning. *ArXiv Preprint ArXiv:1802.01557.*
L. De Raedt, Logical and relational learning. Springer, 2008.

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