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# Individual inconsistency and aggregate rationality: overcoming inconsistencies in expert judgement at the technical frontier

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## ABSTRACT

Commercialization of a new material or process invention can take decades, with factors contributing to this delay including a predominance of tacit knowledge, information asymmetries, and insufficient human capital with knowledge in the field. Focusing on an emerging technology which offers an extreme example of such issues, we seek to capture what expert decision-making looks like at the technological frontier and opportunities that may exist for interventions to accelerate the commercialization of technologies with these issues. We develop a survey to elicit implicit and explicit knowledge of experts about the feasibility of producing parts with metal additive manufacturing (MAM), then recruit 27 of 65 world experts across industry, academia, and government to complete the survey. We find that no two experts make the same judgments about the feasibility of producing jet engine parts with MAM. Further, the majority of experts exhibit some amount of internal inconsistency (intransitivity) in their judgments about which parts are most feasible. The aggregate of expert knowledge has greater internal consistency, suggesting that relying on one or two experts may lead to considerable divergence from aggregate knowledge. Through resampling the experts, we show the degree of this divergence decreases as the number of experts in a sample set increases. The results suggest that capturing, pooling, and then scaling that aggregate expert knowledge may have potential for accelerating commercialization of new materials and processes.

## BIOGRAPHY

Patrick Funk is a PhD Candidate in the Department of Engineering and Public Policy at Carnegie Mellon University. His PhD research employs machine learning, decision science and optimization methods to accelerate commercialization of new technology. His dissertation is focused on metal additive manufacturing for aerospace as a first test case of this unique methodological process combination. His work aims to develop more efficient and effective methods of combining expert and algorithmic knowledge to speed technology commercialization and adoption.