

## **Streamlining Early Stage Experimental Design**

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The design of experiments guides non-clinical applications such as drug development and production process optimization as an essential tool to navigate the vast space of possible experiments. However, classical design techniques are faced with unique challenges when dealing with limited prior knowledge of influential factors and data reproducibility in the early stages of process optimization. Furthermore, the sheer volume of data generated can become daunting, making custom, experiment-by-experiment analysis infeasible. To address these challenges, we identify the need for a more formalized design and analysis framework that can effectively handle the intricacies of early-stage experimental design. We propose to establish such a framework by defining sets of possible experiments which streamline the planning and analysis of early stage process optimization. These experimental modules are established based on a real-world material development project currently in progress, which exhibits the typical characteristics of early-stage experimental design endeavors. In our preliminary assessment, we identified four characteristically different experimental modules: i) screening ii) optimization iii) model improvement iv) validation. Each of these modules corresponds to standardized, out-of-the box experimental design and data analysis techniques which differ in their objectives. Such a standardized approach might be a valuable tool for statisticians practically involved in early stage process optimization. We conclude that early stage process optimization benefits from streamlined design and analysis of experiments, which differ from conventionally considered optimal techniques.