To remain competitive in today’s demanding economy, there is an increasing demand for improved productivity and scrap reduction in manufacturing. Traditional manufacturing metal removal processes such as turning and boring are still one of the most used techniques for fabricating metal products. Although the essential metal removal process is the same, new advances in technology have led to improvements in the monitoring of the process allowing for reduction of power consumption, tool wear, and total cost of production. Replacing used CNC lathes from the 1980’s in a manufacturing facility may prove costly, thus finding a method to modernize the lathes is vital.

This research focuses on Phase I and II of a three phase research project where the final goal is to optimize the simultaneous turning and boring operation of a CNC Lathe. From the optimization results it will be possible to build an adaptive controller that will produce parts rapidly while minimizing tool wear and machinist interaction with the lathe. Phase I of the project was geared towards selecting the sensors that were to be used to monitor the operation and designing a program with an architecture that would allow for simultaneous data collection from the selected sensors at high sampling rates. Signals monitored during the operation included force, temperature, vibration, sound, acoustic emissions, power, and metalworking fluid flow rates. Phase II of this research is focused on using the Response Surface Method to build empirical models for various responses and to optimize the simultaneous cutting process. The simultaneous turning and boring process was defined by the four factors of spindle speed, feed rate, outer diameter depth of cut, and inner diameter depth of cut. A total of four sets of experiments were performed. The first set of experiments screened the experimental region to determine if the cutting parameters were feasible. The next three sets of designs of experiments used Central Composite Designs to build empirical models of each desired response in terms of the four factors and to optimize the process. Each design of experiments was compared with one another to validate that the results achieved were accurate within the experimental region.

By using the Response Surface Method optimal machining parameter settings were achieved. The algorithm used to search for optimal process parameter settings was the desirability function. By applying the results from this research to the manufacturing facility, they will achieve reduction in power consumption, reduction in production time, and decrease in the total cost of each part.

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The public is welcome to attend.