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NIST Generic Clearance for Usability Data Collections

NIST Machinery Maintenance Survey

FOUR STANDARD SURVEY QUESTIONS

1. Explain who will be surveyed and why the group is appropriate to survey.

The manufacturing atmosphere is continually changing with new technologies and standards being developed. Firms create competitive advantages using their knowledge, skills, supply chains, and processes to create superior products at lower prices and/or lower environmental impacts. In such an environment, efficient machinery maintenance methods can mean the difference between a thriving environmentally sustainable firm and one that loses money and has a high level of environmental impact. Currently, at the national level there is limited understanding of the costs, losses, and subsequent environmental impacts associated with machinery maintenance or the different machinery maintenance techniques. NIST is proposing a study to better understand the inefficiencies that result from different machinery maintenance strategies used by U.S. manufacturers.

NIST is proposing to disseminate the survey in two ways. The first is via mail to a sample selection of establishments registered as manufacturing firms in the Environmental Protection Agency's (EPA) Facility Registry Service. The focus of the survey is on those manufacturers listed as NAICS 333, 334, 335, and 336 – machinery, computer, electronics, and transportation equipment manufacturing; however, it is not limited to these categories. The mail survey will include the questionnaire, a cover letter, and a self-addressed return envelope. Participants contacted through the mail will also be given the option to complete the survey online via a weblink. The second method is to ask for volunteers at conferences, through publications, and other relevant media outlets where manufacturers are present. Respondents can fill out a paper copy of the survey or an electronic/web version.

Three maintenance strategies are to be compared:

- **Predictive maintenance**, which is analogous to condition-based maintenance, is initiated based on predictions of failure made using observed data such as temperature, noise, and vibration.
- **Preventive maintenance**, which is related to scheduled maintenance and planned maintenance, is scheduled, timed, or based on a cycle
- **Reactive maintenance**, which is related to run-to-failure, corrective maintenance, failure-based maintenance, and breakdown maintenance, is maintenance done, typically, after equipment has failed or stopped.

Understanding the costs and losses of these strategies can facilitate reducing waste thereby reducing costs and environmental impacts that result from the manufacturing process. The EPA

Facility Registry Service lists any establishment that has an environmental impact. Given that environmental impact is a component of this work and that most manufacturers are listed, it is a good population to survey. The list also provides the industry categorization; thus, it is useful for selecting establishments from specific industries.

There are some concerns about the response rate of a mail survey; therefore, a parallel alternative is being pursued. Individuals will be asked to respond to the survey at relevant manufacturing conferences and through relevant publications.

No PII is collected and this is not a Privacy Act System of Records and does not require a Privacy Act Statement or SORN.

2. Explain how the survey was developed including consultation with interested parties, pre-testing, and responses to suggestions for improvement.

This survey was created by the Applied Economics Office at the National Institute of Standards and Technology. It was developed with input from economists, industry experts, and practitioners. Staff at multiple manufacturing facilities were consulted in developing the survey. A literature review and a report was drafted on the current knowledge on maintenance data and data collection. The survey was also reviewed by multiple NIST staff members. NIST has sought out the incite of manufacturers at the International Manufacturing Technology Show and the PHM Society annual conference.

3. Explain how the survey will be conducted, how customers will be sampled if fewer than all customers will be surveyed, expected response rate, and actions your agency plans to take to improve the response rate.

The survey will be sent to a random selection of manufacturing businesses listed in the Environmental Protection Agency's Facility Registry Service. The focus of the survey is on those manufacturers listed as NAICS 333, 334, 335, and 336 – machinery, computer, electronics, and transportation equipment manufacturing; however, it is not limited to these categories. This survey will be conducted through the mail with the option of completing the survey online. Research suggests that a response rate between 30 % and 50 % can be expected for a mail survey and a response rate of 33 % for an email survey.[1,2] To increase response rates, follow-up and reminders will be conducted via telephone and mail. The survey will also be distributed/announced at selected conferences; however, these responses will be identified separately from those that received a survey through the mail, as conference respondents may

1 Shih, Tse-Hua and Xitao Fan. 2009. "Comparing Response Rates in e-mail and Paper Surveys: A Meta-Analysis." Educational Research Review. Vol. 4 iss. 1.
https://www.sciencedirect.com/science/article/pii/S1747938X08000055

represent biased sampling. It is expected that the survey be sent to 500 businesses and will take 25 minutes to complete. The estimated burden hours, are: 500 (businesses) * 25 minutes / 60 (minutes) = 208 burden hours.

The mail delivered paper survey will include the questionnaire, a cover letter, and a self-addressed return envelope.

4. Describe how the results of the survey will be analyzed and used to generalize the results to the entire customer population.

The responses of the survey will be used to estimate the aggregate costs, losses, and benefits of moving from reactive maintenance to predictive maintenance. Results will be stratified by establishment size and scaled up using payroll data and/or employee data. The aggregated totals will be for a selection of manufacturing subsectors: machinery, computer, electronics, and transportation equipment manufacturing. The variation in responses are also to be examined along with statistical significance. Since the survey is an anonymous response survey, no individual respondents will be revealed.

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2 Prairie Research Associates. “Response Rates on Mail Surveys.” Technote. http://www.pra.ca/resources/pages/files/technotes/rates_e.pdf