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EVALUATION OF THE IOWA HEARTLAND TECHNOLOGY NETWORK

John C. Dugger, Janet D. Sweeney, and Christine Sorenson

John C. Dugger is the Chairman of the Department of Industrial Education and Technology at Iowa State University. Janet Sweeney is the Associate Director of the Research Institute for Studies in Education at Iowa State University. Christine Sorensen is a research assistant with the Research Institute for Studies in Education

The Heartland Technology Network (HTN) evaluation was designed to provide information to decision makers to guide the continuous improvement of HTN services to Iowa manufacturing organizations. The major goals and tasks addressed by this evaluation effort included: (1) soliciting input from industry and primary service providers in designing and implementing an evaluation process; (2) identifying, reviewing, and modifying existing instruments for use in assessing manufacturing organization needs; (3) identifying, adapting, and developing instruments to measure the results of company participation in HTN at four levels defined by Kirkpatrick (1979) including reactions, changes in knowledge, and practice, and organizational impacts; (4) developing reporting and data collection procedures; and (5) generating status reports for the funding agency.

The following sections contain a description of the activities and the results of the HTN evaluation. This summary encompasses the major activities of the entire project from September, 1992 through March 31, 1994.

Evaluation Activities and Products

To gather input regarding the design and implementation of HTN's evaluation, an advisory panel was formed which included representatives from Iowa manufacturing companies, the regent institutions, the community college presidents, the community college vocational and technical deans, the Center for Industrial Research and Service (CIRAS), and the Iowa Quality Coalition. The Advisory Panel provided significant insights during the development of strategies for evaluating HTN activities.

As a result of the panel's input, direct contact with companies by the Evaluation Team was limited to telephone interviews at process completion points. Collecting data through the HTN specialist became an integral part of the evaluation process, as did the strategy of asking service providers, through the specialist, to submit specified data. The advisory panel was also involved in determining the

content of the reporting form for HTN specialists and the content of telephone surveys.

Evaluation Model

One accomplishments of this evaluation effort was the development of a comprehensive evaluation model. Literature in the areas of industrial technology and technology transfer was reviewed for evaluation models. Information was also gathered from federally funded National Institute of Standards and Technology (NIST) centers, economic development specialists at Iowa community colleges, CIRAS, and the Iowa Small Business Development Center (SBDC) about program evaluation methods. Key components of selected models were incorporated into the HTN evaluation model with further refinements made through recommendations by the advisory panel and the HTN specialists (field agents).

The model encompasses both the technology transfer process and specified evaluation activities (Figure 1). Data are collected by the specialists, service providers, and the Evaluation Team at different points in the process. Following identification of selection criteria by the specialists (step 1 in Figure 1), contacts are made with targeted companies (step 2) that result in one of three possible outcomes: (1) participation in an assessment process; (2) recommendations to address company identified needs; or (3) a decision not to participate (refer to steps 2.1, 2.2 and 2.3 in Figure 1).

The specialist chooses the appropriate data collection technique for companies participating in an assessment process (step 3 in Figure 1), which in many cases begins with the Customer Assessment Protocol (CAP). The person or organization conducting the initial data collection is responsible for evaluating the company's reaction to the instrument or tool used to collect data and for providing a report to the Evaluation Team (referred to as the manufacturing data report in Figure 1). Following initial data collection, the specialist selects a team to conduct a site visit (step 4), review the data, and provide recommendations for the company (step 5). Companies may choose to discontinue services at two key points in the process, following initial data collection (steps 3.1 and 3.2) or following presentation of recommendations (steps 5.1 or 5.2).

Throughout the HTN process, the specialist reports data to the Evaluation Team for inclusion in an electronic database. These reports are referred to in Figure 1 as the specialist's contact report, specialists recommendation report, and specialists implementation report. The Evaluation Team collects data through telephone interviews when a company decides to discontinue services at identified points in the model. The points where the Evaluation Team collects telephone data are referred to in Figure 1 as the telephone follow-up to initial contact, telephone follow-up to data collection, and telephone follow-up to recommendations.

Following the presentation of recommendations, the company chooses whether to continue with an implementation program (step 6, implementation of assistance). Three types of information are to be gathered during the implementation phase to help in determining the effectiveness of the process. The three types of information collected are based on the levels of evaluation defined by Kirkpatrick.[1] Kirkpatrick discusses assessing changes in attitudes resulting from training programs (level 1), changes in knowledge among training program participants (level 2), and changes in practices within the company resulting from participation in the training program (level 3).

Service providers collect surveys to determine perceptions of training programs and attitudes of participants (level 1 - attitude). Service providers in cooperation with the company and the specialist also choose from several options to assess changes in participant knowledge (level 2). HTN specialists in cooperation with the company may choose from several options to determine changes in organizational practices (level 3) which are measured approximately three to six months after completion of the implementation. All data

[1] Kirkpatrick, D.L. (1979). Techniques for evaluating training programs. *Training and Development Journal*, 33(6), 78-92.

collected related to these three levels of evaluation are submitted to the Evaluation Team by the HTN specialist (specialist implementation report in Figure 1).

Prior to implementation of programs, specialists are to collect quantifiable data to be used as a baseline for determining long-term impacts on the organization. The selection of measures to be used to assess impact was determined by the specialist in collaboration with the company. Comparison data is collected one year following completion of the implementation program (step 7 in Figure 1).

Evaluation Instruments and Reporting Procedures

Based on recommendations by the Advisory Panel and the HTN specialists, the Evaluation Team developed several instruments and determined procedures for collecting data. Three short scripted telephone interviews were developed for data collection at process completion points (identified in Figure 1). Results of these surveys were provided to specialists as part of the formative evaluation process.

The Evaluation Team also developed instruments to evaluate manufacturing assessment tools used to determine company needs (Step 3.0 in Figure 1). Customer Assessment Protocol (CAP) personnel collaborated in developing a set of questions for evaluating the CAP, which was administered by three Iowa community colleges. These questions were recorded immediately following the CAP process and use software incorporated into the CAP program. A similar questionnaire was developed for use with other assessment instruments used as part of the HTN process.

A survey instrument was also developed to assess perceptions of participants in training programs (attitude assessment). Specialists provided this instrument to service providers. Service providers were also requested to measure changes in knowledge for participants in training programs. Guidelines were developed by the Evaluation Team with options for measuring changes in knowledge. The HTN specialist selected the appropriate measure in cooperation with the service provider.

Changes in practice were measured for all implementation programs, regardless of whether they include training. The purpose of this evaluation was to identify changes that have occurred in the organization as a result of HTN. Options and sample questions for assessing changes in practice were provided by the Evaluation Team. The company and the specialist agreed on the timeline for measuring changes in practice and the method of data collection.

Because of the diversity of companies using the HTN, the impact of the HTN process was defined narrowly as the impact on a specific company. Measures to determine impacts were dependent on the needs and strategies identified for each company. Impact measures were quantifiable and directly related to company needs. Examples of impact measures were provided to HTN specialists. Specialists identified selected measures in collaboration with the company.

As part of the HTN evaluation, data are reported by specialists continuously through the use of a standard form. A standard report form was developed by the Evaluation Team after reviewing the literature, contacting NIST centers, and consulting the Advisory Panel and HTN specialists. The report form was incorporated into a software program HTN specialists use for project management. Copies of these reports were sent to HTN management and forwarded to the Evaluation Team where the data are compiled. The report form was revised in Spring 1994 to reflect several NIST requirements. The Evaluation Team provided all specialists with an evaluation manual which included copies of all evaluation instruments, procedures, and report forms.

Specialist Training

The Evaluation Team participated in twelve training sessions for HTN specialists between November 1992 and March 1994. The initial training sessions in November and December 1992 were to outline the HTN program and evaluation process for the newly hired HTN specialists. Evaluations of these sessions were conducted and

overall ratings were generally positive. Several areas for further training were identified and these topics were addressed in later sessions.

Topics addressed by the evaluation team during participation in training sessions included using the assessment process, identifying company needs, identifying strategies to meet company needs, the evaluation process, reporting procedures, the status of the database, and changes in reporting based on NIST requirements. The Evaluation Team also used the training sessions as an opportunity to share evaluation findings with the specialists.

Publications

Three newsletters have been published during the project to facilitate communication about evaluation activities. The newsletters, titled ***HTN Evaluation Update***, were distributed in April, July, and November 1993 to WTTF, HTN specialists, community college presidents, community college vocational and technical deans, and Advisory Panel members. Newsletter topics included the goals of HTN evaluation, the evaluation model, the HTN Advisory Panel, training activities, evaluation of the implementation phase, and summaries of evaluation results.

Summary of Evaluation Results

This section of the report summarizes the data collected as part of the HTN evaluation process which reflects the data reported by the HTN specialists to the Evaluation Team. All information received through March 31, 1994 is included. The data pertain to companies choosing to participate in the HTN process; those still undecided about participation are not included in the analysis. Additional companies may have been contacted by specialists, but not reported to the Evaluation Team.

Selection Criteria

HTN specialists identified criteria for selecting companies to participate in the HTN process. These selection criteria varied across regions, with specialists using type of industry and company size as key criteria. The Evaluation Team compared database information on number of employees and Standard Industry Codes (SIC) with these selection criteria. Nearly all companies participating in HTN met the specified criteria.

Specialist Reports

Company Participation in HTN. From September 1, 1992, through March 31, 1994, the HTN specialists reported contacting 222 companies. Among these companies, 152 were reported as choosing to participate in the HTN process and eight elected not to participate. The remainder were assumed to be in the decision-making stage. Among the 152 participating companies, 66 chose to complete an assessment process to identify needs; 86 had self-identified needs and chose not to participate in an assessment process. The CAP was conducted with 47 of the companies going through the assessment phase. Other types of assessment were conducted with 12 companies. One company chose to discontinue participation in HTN following the initial assessment phase while 55 decided to continue with a team visit. As of March 31, 1994, 46 of the companies participating in the assessment process had completed site visits and had received recommendations for action. Seventy-two of the 86 companies with self-identified needs had received recommendations. Among the 118 companies receiving recommendations, 80 decided to continue with an implementation program and one company chose not to proceed. Thirty-seven of the 80 companies choosing to implement recommendations went through an assessment, while 43 had self identified needs. Among the 80 companies choosing to implement assistance programs, 69 had implementation programs in progress as of March 31, 1994; thirty-four had gone through an assessment phase and 35 had self-identified needs.

Description of Participating Companies. Most of the 152 companies participating in HTN had fewer than 100 employees (80%), and nearly two-thirds (63%) had fewer than 50 employees. Participating companies with more than 100 employees were more likely to have self-identified needs. About 40 percent of the 152 participating companies had annual sales of less than $5 million and over half reported annual sales of under $10

million (Figure 5). Over half of the companies participating in an assessment process reported annual sales of under $5 million.

The primary areas of manufacturing (as determined by SIC codes) for participating companies were commercial machinery (35), fabricated metals (29), and metals (25). Other areas with a number of companies were plastics (15), transportation equipment (11), printing (8), electronics (6), and foods (3). One or two companies each were from the areas of lumber and wood, chemicals, measuring instruments, furniture, apparel and fabric, and miscellaneous.

Needs, Strategies, and Implementation. As part of the HTN process, needs are identified for participating companies. Needs may be identified through a formal assessment process (2.1 in Figure 1), or the company may have self-identified needs (2.2). Multiple needs may be identified. These needs are categorized for reporting purposes. The areas of need identified most frequently for HTN companies include improving product quality (85), improving management systems and practices (49), improving employee performance (44), improving plant efficiency (30), increasing productivity (28), enhancing environmental efficiency (24), and improving product design (22). The need to improve product quality was identified for 60 companies, while improving management systems and practices was identified as a need for 40 companies and improving employee job performance was a need for 36 companies. Only two companies identified a need for upgrading equipment.

Following the needs identification stage, strategies were recommended to the company to address those needs. A strategy may be utilized to meet several areas of need. Recommended strategies reported by the specialists have been coded and categorized according to NIST requirements. Strategy areas mentioned most frequently include quality/inspection (61), human resources (61), other areas not defined by NIST (47), process improvement (32), business management/systems (29), and market development (24). Strategies recommended for the greatest number of companies included human resources (46 companies), quality/inspection (43 companies), and other strategies not categorized by NIST (42 companies). Strategies recommended for few companies included EDI/communications/LAN (3) and automation/robotics (4).

Once a company had received recommendations, a decision had to be made about whether to implement these strategies. Currently, 80 companies have decided to begin implementation programs and 69 have implementation programs in progress. For those with implementation programs in progress, the strategies being implemented have been coded (again using the NIST definitions). The areas in which implementations are most frequently reported include human resources (37), quality/inspection (29), other areas not defined by NIST (19), process improvement (18), business management/systems (17), and environmental (14). Thirty companies have implementation programs in the area of human resources and 23 in quality/inspection. No companies had strategies implemented in the area of material engineering while few had implementation in the areas of CAD/CAM/CAE (3), EDI/communications/LAN (3), and automation/robotics (3).

Impact Measures. As part of the HTN process, specialists were asked to identify, in cooperation with the company, several quantifiable measures to assess the impact of the program on the company. Specialists were asked to report the measures to be used and to collect pre-implementation data on these measures. Twenty-three of the 34 companies currently implementing programs after participating in a formal assessment process and 23 of the 35 companies implementing programs to meet self-identified needs had identified quantifiable measures. The remaining 23 companies with implementation programs had no reported measures. Two companies had measures reported but no implementation program in progress.

Telephone Follow-ups

Telephone follow-up interviews were conducted by the Evaluation Team with companies who had decided not to participate in the HTN process. One company contact person declined to

respond to the survey. Responses from the remaining seven companies indicate that the contact persons understood the role the HTN specialist. Over half of the respondents were unsure that the presentation provided a clear idea of how HTN could assist their company. Reactions were mixed on whether the company contact felt the specialist listened to and understood their concerns with three agreeing and two disagreeing. Three felt costs for participating were adequately explained while two were unsure and one felt the costs were not adequately explained. Three felt that HTN could provide assistance to companies such as theirs and would recommend HTN services to others. However, three felt HTN could not provide the assistance companies such as theirs needed. Five of the seven respondents agreed that they would give the specialist a positive rating.

When looking at the means for the Likert-scale items, respondents generally agreed that they understood the role of the specialists (3.83) and would give the specialist a positive rating (3.57). The mean scores for the other items ranged from 3.00 to 3.40. In some cases the mean rating did not reflect the distribution of responses.

When asked to describe what was most positive about the meeting with the HTN specialist, respondents appreciated the attitude of the specialist and the fact that services were being offered. Suggestions for improving the meeting included providing clearer definitions of services and better preparation on the part of the specialist. Services that respondents believed companies would find useful included handling waste and hazardous materials, bench marking, and updates on changing electronics. Only two companies indicated that they had needs in their company that were not currently being addressed. Reasons for non-participation were divided. Some felt that HTN could not provide the services they needed, while some indicated that timing was a problem and they might consider HTN services at a later date.

Implementation Phase Evaluation

Four levels of evaluation were incorporated in the implementation phase of the HTN process. These levels were discussed earlier. Level one assessed attitudes toward training programs, level two measured changes in knowledge, level three measured changes in practice, and level four assessed the impact on the company. General survey instruments were developed for assessing attitudes of training participants and copies were distributed to specialists. As of March 31, 1994, none of these surveys had been returned. However, one specialist in Region B provided attitude assessment data collected during two community college JIT training events at HTN companies. The community college personnel used their own survey instrument. A total of 17 employees participated in the training events. Based on these responses, it appeared that participants were satisfied with the training they received.

Procedures were developed and distributed to specialists for collecting data about changes in knowledge (level 2) and practice (level 3). No level two or level three measures were reported to the Evaluation Team between November 1, 1992 and March 31, 1994.

Impact measures will be based on data collected one year following the completion of an implementation program. These data are to be compared with baseline measures collected by the specialist prior to implementation (measurable indicators). No baseline measures had been reported as of March 31, 1994.

Specialist Survey

In October 1993, all eleven HTN specialists responded to a survey asking them to identify (1) the most positive impacts of HTN; (2) aspects of the program that have worked well; (3) difficulties in implementing the HTN process; (4) the greatest challenges for the future; and (5) recommended changes. Their responses provided insights about the effectiveness of the HTN process from the perspective of those who are using it in the field.

All eleven specialists identified support and assistance to companies as the most positive impact of HTN. This support took many forms, including establishing consortia, conducting company assessments, developing modernization plans, helping companies during flooding, and providing technical assistance and information. Other positive

impacts identified included increased awareness and utilization of available resources and improved relationships with companies and service providers.

Aspects that about half of the specialists identified as working especially well included access to expertise and technical resources and the ability to offer meaningful, personalized assistance to companies. Other aspects mentioned included the formalized HTN process, assessment procedures, and sharing among specialists at regularly scheduled meetings.

Specialists identified lack of public and private resources such as time, money, knowledge, and tools as significant barriers to implementing the HTN process. Other identified barriers included lack of an HTN identity; the need to clarify the working relationship between community colleges and HTN; difficulties with on-site review teams including recruiting members, scheduling visits, and the inability to pay team members; and distrust and unwillingness to change on the part of companies. The greatest challenges appear to be obtaining additional resources and improving performance, both identified by over half of the specialists.

Asked for recommendations for changes, specialists indicated a need for need for more time for peer interactions and critiques and needs for additional training, particularly in areas such as problem identification, assessing needs, and reporting procedures. Specialists would also like better access to a variety of resources, clarification of the HTN/community college working relationship, stronger HTN leadership, better resource sharing, and accountability among service providers.

Conclusions and Recommendations

A general conclusion resulting from the evaluation of the HTN from September, 1992 through March, 31, 1994 is that Iowa companies served through the HTN have a variety of needs that are being met through a variety of strategies being provided by a number of service providers. Presented below are a number of specific conclusions related to the HTN evaluation process. Each conclusion is followed by a recommendation for action.

Conclusion. The evaluation process developed for HTN will transition well to the monitoring procedures required by NIST.

Recommendation. The Iowa Manufacturing Technology Center (IMTC) should draw heavily upon the processes, procedures, and materials developed through the HTN in developing the evaluation process for the IMTC.

Conclusion. Companies participating in a formalized assessment process, such as the Customer Assessment Protocol (CAP), are more likely to have implemented recommended improvement strategies (52%) than are companies with self-identified needs (41%). In addition, companies completing the assessment phase have more needs identified (172 for 47 companies) and more improvement strategies recommended (137) than do companies with self-identified needs (139 needs identified and 129 strategies recommended for 71 companies). This indicates that companies going through assessment may have more needs identified and a greater variety of strategies recommended. However, there is an inconsistent application in the use of an assessment process across the regions. Some regions rely more heavily on standardized assessment tools (e.g. CAP) to determine needs than do other regions.

Recommendation. Utilization of a formal assessment process should be promoted and all specialists should become familiar with assessment tools.

Conclusion. The CAP process is perceived positively by participating companies, although it may have limited applications for some specific types of companies, such as job shops and service industries.

Recommendation. The CAP should continue to be available as an assessment tool; however, it is important to be aware of its limitations for certain kinds of companies and continue to seek information about other instruments.

Conclusion. Small and medium sized manufacturers appear more likely to receive recommendations that are human resource (39%) or quality (36%) oriented rather than equipment

oriented (control systems, 7%; CAD/CAM, 6%; robotics, 3%; EDI/LAN, 3%), and among companies implementing recommendations (69), over one-third of the implementation strategies are related to human resources (43%) or quality (33%) while few companies have implemented strategies that are equipment related (control systems, 11%; CAD/CAM, EDI/LAN, and robotics, 3% each).

Recommendation. Specialists should continue to recognize that implementation strategies related to personnel and quality are of significant benefit to small and medium sized companies.

Conclusion. Specialists appear to more frequently recommend the strategies with which they are most familiar. Recommendations may be oriented towards the training mission of the community college and the expertise of the specialists and may not take advantage of the full spectrum of possible strategies.

Recommendation. Additional training for specialists on a variety of strategies is needed. Companies have diverse needs that must be met using a wide spectrum of strategies and service providers.

Conclusion. There is an unevenness across the regions concerning the types of service providers used. For example, one region utilized 23 different service providers while two regions utilized two or three service providers.

Recommendation. A statewide database of service providers should be established. It may be that limitations in the types of service providers being utilized are due to a lack of knowledge on the part of the specialists about the services available. A database that could be accessed by all specialists would likely address this need.

Conclusion. A wide variety of measurable indicators have been identified by the participating companies to determine the impact of the HTN, indicating that it may not be appropriate to have standardized impact measures.

Recommendation. Measurement of impact should continue to be done on a company-by-company basis in addition to the standardized measures required by NIST for the IMTC.

Conclusion. The data collection process does not appear to work particularly well in those areas where the responsibility for data collection rests with the specialist or service provider. Data simply are not being collected at the level necessary to evaluate the impact of the program.

Recommendation. The responsibility for data collection to measure impacts should be shifted from the specialist and service provider to internal evaluators. Since the NIST procedures do not require this data collection by the specialist or agent and the service provider, a shift is likely to occur naturally as the HTN evaluation transitions to the IMTC evaluation.

Conclusion. Specialists are hesitant to report companies as non-participants, therefore the follow-up surveys are of little use in formative evaluation due to the low number of responses.

Recommendation. Formative evaluation could be improved by conducting follow-up surveys of all clients. This may be addressed with the implementation of NIST requirements for the IMTC.

Conclusion. Site visits to specialists and companies provide an opportunity to explore the difficulties and needs of HTN related to data collection from small and medium sized companies.

Recommendation. The addition of qualitative evaluation techniques would enhance understanding of the successful practices in assisting small and medium-sized manufacturers.

Conclusion. Some regions appear to be more successful in "selling the program" to companies than others.

Recommendation. Consideration should be given to utilizing training programs that focus on effective sales techniques.

Conclusion. Providing assistance to companies is a long-term process. Those anticipating quick results from this or similar programs are likely to be disappointed.

Recommendation. Evaluation of effectiveness of the program should be focused on long-term rather than short-term measures.

INSERT FIGURE 1