A REVISED ON-THE-JOB TRAINING SYSTEM AT

JOHNSON MATTHEY ELECTRONICS

Benefits Of Training Materials
For On-The-Job Training

by

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A Research Paper

Submitted in Partial Fulfillment of the
Requirements for the
Master of Science Degree in
Training and Development

Approved for Completion of 4 Semester Credits
TRHRD-735 Field Problem in Training and Development

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The Graduate College
University of Wisconsin-Stout
August, 1999

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ABSTRACT

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A REVISED ON-THE-JOB TRAINING SYSTEM AT JOHNSON MATTHEY
(Title)

ELECTRONICS: Benefits Of Training Materials For On-The-Job Training

Training and Development	Joe Benkowski	July, 1999	53
(Graduate Major)	(Research Advisor)	(Month/Year)	(No. of Pages)

APA
(Name of Style Manual Used in this Study)

THIS FIELD PROBLEM STUDIED THE BENEFITS OF THE USE OF TRAINING CHECKLISTS AND LESSON PLANS IN ON-THE-JOB TRAINING. CHAPTER 1 IS AN INTRODUCTION TO THE ORGANIZATION THAT THE RESEARCH WAS CONDUCTED, ALONG WITH A STATEMENT OF THE PROBLEM AND THE OBJECTIVES OF THE STUDY. CHAPTER 2 DESCRIBES THE HISTORY AND RESEARCH THAT HAS BEEN CONDUCTED ON ON-THE-JOB TRAINING, INCLUDING THE USE OF TRAINING CHECKLISTS AND LESSON PLANS IN ON-THE-JOB TRAINING. CHAPTERS 3 AND 4 SPECIFY THE RESEARCH METHODS THAT WERE USED TO COLLECT DATA AND THE RESULTS OF THE

RESEARCH. CHAPTER 5 CONCLUDES WITH A SUMMARY OF THE RESEARCH AND PROVIDES RECOMMENDATIONS ON THE REVISED TRAINING SYSTEM, ALONG WITH RECOMMENDATIONS FOR FURTHER RESEARCH.

Acknowledgements

I would like to sincerely express my appreciation and gratitude to everyone who assisted me in this research project. I would first like to thank Dr. Joe Benkowski, my research advisor and the Program Director of the Training and Development Master's program. I am very grateful for the time, interest, advice, and encouragement that he provided me.

I would also like to thank Johnson Matthey Semiconductor Packages in Chippewa Falls, Wisconsin for allowing me to conduct research at their organization for this field problem. In particular, I would like to thank Linda Kreuger-Smith, my manager, and the Training, Education, and Development Manager, along with Tom Zweifelhofer, the manager of Human Resources. I thank them both for their advice and approval to conduct the research.

Finally, I would like to thank my husband, Michael, my children, Elizabeth and Beau, and my parents, Earl and Georgia Hilber. Their encouragement, support, and endless patience made it possible for me to accomplish this research paper and complete my education.

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Chapter 1

INTRODUCTION

Introduction to the Field Problem

This field problem is focused on the on-the-job training system at Johnson Matthey Semiconductor Packages, Inc., in Chippewa Falls, Wisconsin. On-the-job training is an important component in the operation of Johnson Matthey because it is used to ensure that employees are qualified and are performing jobs as efficiently as possible; however, on-the-job training has not always been the strongest link in the organization due to lack of time to train operators and insufficient training materials. In order to improve on-the-job training, the training system was revised by the researcher, along with others in the organization, and benefits of the changes were evaluated and documented by means of this research project.

Introduction to Johnson Matthey

Johnson Matthey is a diverse company that employs approximately 12,000 employees in 38 countries (Johnson Matthey, 1997). Johnson Matthey was founded in 1817 in London, England in the precious metals business. Over time, the company expanded into metal and technology-related businesses (Johnson Matthey, 1997). Johnson Matthey currently consists of four main divisions (Refer to Figure 1.):

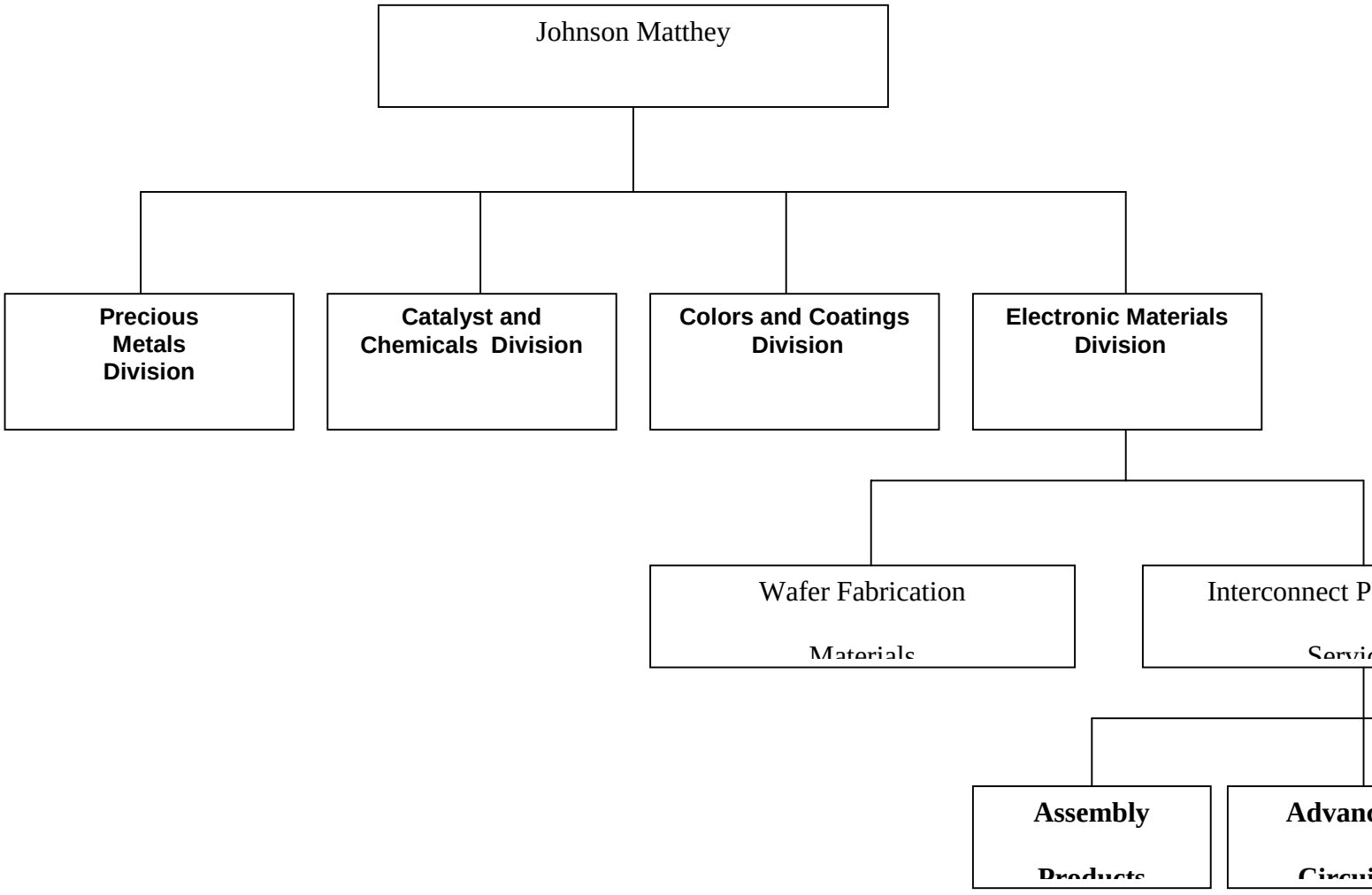
1. The Precious Metals Division, which includes platinum fabrication, and gold and silver refining industries.
2. The Catalyst and Chemicals Division, which consists of autocatalyst, pharmaceutical ingredients, and specialty chemicals businesses.

3. The Colors and Coatings Division, which manufactures glazes used in decorating ceramics (e.g., glassware, tableware, and tiles), inks, and pigments used in paints and inks.
4. The Electronic Materials Division, which manufactures microelectronic materials and components. The Electronic Materials Division is broken down into two divisions:
    a. Wafer Fabrication Materials, which produces high-purity copper and other metals, sapphires, and thermocouples (temperature sensors used in furnaces).
    b. Interconnect Products and Services, which supply printed circuit boards and semiconductor materials and packages. This division consists of three groups:

- Assembly Products, which supply products used in semiconductor packages.
    - Advanced Circuits, which manufacture printed circuit boards used in telecommunications, pagers, computers, etc.
    - Semiconductor Packages, which manufacture plastic laminate semiconductor packages. Semiconductor Packages was established in April, 1996 when Johnson Matthey bought the Cray Research Printed Circuit Board Facility in Chippewa Falls, Wisconsin (Johnson Matthey, 1997).

Research for this field problem was conducted at Johnson Matthey Semiconductor Packages; any further reference to “Johnson Matthey” in this research paper will imply the Semiconductor Packages Division in Chippewa Falls, Wisconsin.

Figure 1: Johnson Matthey Divisions



Introduction to the On-the-Job Training System at Johnson Matthey

In 1996, when Johnson Matthey purchased the printed circuit board facility in Chippewa Falls, the company adopted the OJT process that the previous organization used. At that time, OJT consisted of trainees observing a line trainer, practicing the job on their own, and reading and following the procedures outlined in the work instruction. Training was complete when it was determined by the line trainer and the supervisor that the trainee could perform the job on his or her own. At this point, the line trainer would complete a yes/no training checklist (Appendix A) and an employee from outside the work area (who usually had no knowledge of the job) would certify the employee using a certification checklist (Appendix B). Upon completion of this documentation, the trainee was considered an "expert" on the job(s) (s)he was certified on.

Since 1996, the Johnson Matthey training department has revised this training process. The current components of the revised on-the-job training system at Johnson Matthey include qualified Certified Operator Trainers (COTs) and systematically-designed training materials. On-the-job training is performed by COTs who are line operators selected through an interviewing process by the area supervisor and manager. Qualified COTs are chosen based on their expertise on the job(s) and the training

qualities they display. COTs develop their training skills by attending a Train-the-Trainer course to learn techniques that enhance job demonstration, explanation, communication, and training skills. Attendance of the Train-the-Trainer course also certifies and qualifies the selected line operators to be COTs.

The training materials are the other major component of Johnson Matthey's revised OJT system. There are four documents that have been developed to be used in OJT: Process Operating Manual, Control Plan, Training and Certification Guide, and Trainer's Notes. The Process Operating Manual is a document that contains the step-by-step procedures involved in performing a job. It also includes pictures and diagrams to help the trainee (and trained operator) most effectively learn and understand what they are reading and doing in that job. The Process Operating Manual is to be used as a reference to assist in training and also as a job aid for the trained operator. The Control Plan is a chart that outlines the machine and product parameters and specifications. The Control Plan is also to be used as a reference in training (as an accessible reference to machine and product requirements). The Training and Certification Guide is a combined training checklist and certification form that is used to guide on-the-job training and certifying (Appendix C). The Training and Certification Guide outlines the training expectations and provides a measurement of learning and skills acquisition. The COT and trainee follow the Training and Certification Guide until training is complete and the trainee can perform each task to the standard requirement (Johnson Matthey, 1999). The Trainer's Notes is a detailed lesson plan used by COTs in on-the-job training (Johnson Matthey, 1999). COTs refer to the Trainer' Notes for training resources, time, and objectives of each lesson (Appendix D). All four documents are used by the COT to train

and certify operators, and together these documents provide a comprehensive overview of what is entailed in learning and performing a job.

Problem Statement

The problem of this study is to design and evaluate the benefits of training checklists and lesson plans used in on-the-job training at Johnson Matthey Semiconductor Packages.

Research Objectives

The objectives of this study are:

1. To design a viable, generic format for training checklists and lesson plans that can be used in all work areas at Johnson Matthey.
2. To determine the content of training checklists and lesson plans.
3. To evaluate the benefits of training checklists and lesson plans when used in on-the-job training at Johnson Matthey.

Need Statement

On-the-job training can be ineffective due to many factors: inconsistencies between trainers, lack of thoroughness and efforts dedicated to on-the-job training, and

training being overly time-consuming, as discussed in Chapter 2 (Chase, 1996). These factors are present at Johnson Matthey and the need for this study is based on the need to improve on-the-job training in the organization.

Definitions

The following is a list of operational definitions for the terms that apply to this study. These definitions pertain to terms found in references used to research this topic, as well as the terms that relate to Johnson Matthey's training system.

On-the job training (OJT) - (Also referred to as structured on-the-job training, planned on-the-job training, or job instruction training.) In this study, OJT is planned and organized training that is conducted one-on-one by line-trainers at the job site (Johnson Matthey, 1999).

Unstructured On-the-Job Training - (Also referred to as unplanned on-the-job training.) On-the-job training that is not planned or logically organized. Training and learning takes place by trainees performing the work or by watching others perform (Rothwell and Kazanas, 1994).

Off-the Job Training - (Also referred to as classroom training.) Any type of training that is not performed on the job; off-the-job training commonly takes place in a classroom and is designed to train groups of trainees rather than individuals. (Rothwell and Kazanas, 1994).

Certified Operator Trainer (COT) - A line trainer responsible for training and certifying production personnel (Johnson Matthey, 1999).

Technician - An employee whose main responsibilities include troubleshooting equipment and operator errors, maintaining workflow, and assisting in training (Johnson Matthey, 1999).

Supervisor - An employee who oversees the employees and workflow of a specific production area by shift. Supervisors are also responsible for assigning new operators to COTs, tracking training progress, and recording operator certification (Johnson Matthey, 1999).

Instructional Designer - A training professional who develops training materials. At Johnson Matthey, the instructional designer is responsible for working with subject matter experts to develop on-the-job training materials (Johnson Matthey, 1999).

Certified Operator: - A production employee who is certified on the work instructions for the job(s) (s)he is working (Johnson Matthey, 1999).

Training and Certification Guide - A training checklist that is used to guide on-the-job training by outlining the training expectations and providing a measurement of learning and skills acquisition. The COT and trainee follow the Guide until training is complete and the trainee can perform each task to the standard requirement (Johnson Matthey, 1999).

Trainer's Notes - A detailed lesson plan used by COTs in on-the-job training (Johnson Matthey, 1999).

Control Plan - A chart that outlines the machine and product parameters and specifications (Johnson Matthey, 1999).

Process Operating Manual - A manual that contains work instructions, pictures, and diagrams which is used for training and as a reference for certified operators (Johnson Matthey, 1999).

Work Instruction - A document that details step-by-step procedures to perform a job (Johnson Matthey, 1999).

Certification - Validation that the trainee has been trained and is qualified to perform the job. When the training and Certification Guide is complete and signed by the trainee and trainer, the operator is certified (Johnson Matthey, 1999).

Performance Objectives - Detailed statements of what the learners will be able to do and/or know when they complete a lesson. Objectives are written in terms of observable and/or measurable behavior (Kelly, 1995).

Lesson Plans - "Detailed outlines intended to guide instructors through group or individualized instructional activities" (Rothwell and Kazanas, 1992, p. 212).

Electrical Test - A work area that uses high-technology equipment to tests the continuity of the flow of electricity through circuits (Johnson Matthey, 1999).

Automated Optical Inspection (AOI) - A work area that inspects and repairs defects on printed circuit layers and boards (Johnson Matthey, 1999).

Soldermask - A work area which consists of five processes that place a mask material on printed circuit layers and boards to protect the metals during the manufacturing procedures that follow (Johnson Matthey, 1999).

Limitations

Limitations of this study include the following:

1. The research was completed in three months (limited time).
2. The research was conducted at one site in one organization: Johnson Matthey Semiconductor Packages.

3. The Trainer's Notes were implemented in three of ten work areas: Electrical Test, Soldermask, and Automated Optical Inspection.
4. Since the study did not contain an experimental design or random sampling, there were change factors and other variables that were not considered in the outcomes of the study.

Assumptions

The assumptions of this study are that the results reflect operations at Johnson Matthey Semiconductor Packages in Chippewa Falls, Wisconsin and should not be generalized to other Johnson Matthey sites or other organizations outside of Johnson Matthey. The effectiveness of the training checklists and lesson plans at Johnson Matthey may be found at other organizations, but additional research should be conducted by others to determine this.

Chapter 2

REVIEW OF LITERATURE

Introduction

Chapter 2 introduces on-the-job training by providing a brief history and explaining the different types of on-the-job training. The chapter also explains the roles of checklists and lesson plans in OJT, and provides an example of a structured on-the-job training program.

History of On-the-Job Training

On-the-job training has been a training method used for almost all types of learning throughout history (Kelly, 1995). OJT is viewed by experts to have originated through merchant and craft guilds and apprenticeships when craftsmen learned through informal training with master craftsmen(Kelly, 1995 and Chase, 1996). However, the apprenticeship system began to break down with the onset of the American Industrial Revolution. As manual labor began to decrease in textile, agriculture, printing, and other industries, and was replaced by more technological and automated machinery, a new method of training was needed in order to train more people faster (than the apprenticeship-style training could support) (Kelly, 1995). "As America entered the twentieth century, and the industrialization of the economy continued, innovations occurred in work design which fundamentally transformed the nature of work: *scientific management* and the introduction of *mass production methods*" (Kelly, 1995, p.4). Both methods were used to break down jobs into several, simple, easy-to-perform tasks and to manage the large numbers of line workers that performed the tasks. Overall, the industrial equipment and simple task-orientated jobs had de-skilling effects on the general workers; the operational methods made on-the-job training very

minimal because line workers had very few tasks to learn and perform (Kelly, 1995).

Further developments in on-the-job training occurred during the two world wars. Kelly explains that modern training methods were influenced and developed by wartime training efforts and innovations (1995). During World War I, Charles Allen developed job instruction training (JIT), a four-step on-the-job training method. World War II led to the Training Within Industry (TWI), a training effort designed to train mass numbers of workers so contractors could get better productivity to support war efforts and to help lower the costs of war materials (Kelly, 1995).

Overview of On-the-Job Training

On-the-job training (OJT), simply stated, is "two people working closely together so one person can learn from the other" (Levine, 1997, p. 1). This form of training is most useful when the work environment is rapidly changing, complex, or highly technological, and thus creates a need for highly skilled workers. On-the-job training is also best used in situations in which the employee does not know how to carry out his or her job due to a lack of knowledge, skills, and/or experience, where job procedures are new or have changed, and in which the equipment or tools are new. On-the-job training is not a useful solution when the employees do not possess the mental or physical capabilities to perform the job, when employees have motivational or attitudinal problems, or when the environment has a high degree of constraints or is very chaotic (Lawson, 1997).

There are two basic categories of on-the-job training: unstructured, which, according to most experts, is used frequently in most organizations, and structured on-the-job training, which is the more recent application of on-the-job training (Hamilton and Hamilton, 1997, Lawson, 1997, Levine, 1997, Filipczak, 1996, Kelly, 1995, and Rothwell and Kazanas, 1994). The first category of on-the-job training is a "shadowing" or "sink or swim" approach in which one employee follows another around, in hopes of the "trainee" learning what the "trainer" is doing. This form of unstructured on-the-job training is an "approach in which learners are 'thrown into' the work," and the training "is based on daily work events rather than the learner/worker needs" (Rothwell, 1997, p. 5).

> This is called *unstructured OJT* because it occurs haphazardly—the employee-trainer (a.k.a. expert) teaches the tasks as he or she remembers them. Because of time or other pressures, important steps may be forgotten or simply skipped. As an unstructured system, no criteria are established for the quality of training, nor are records of the training maintained (Levine, 1997, p. 1).

Bob Filpczak, author of "Frick Teaches Frack," states that unstructured on-the-job training "…doesn't enforce common work standards. It doesn't ensure the trainee will perform the way Sam [the trainer] says they should be done. It allows the trainee to pick up Sam's [the trainer's] bad habits along with his good ones" (Filipczak, 1993, p. 30). Just as on-the-job training experts confirm that most of the on-the-job training that takes place in businesses is unstructured, they agree that unstructured on-the-job training is the least beneficial and least effective type

of training (Hamilton and Hamilton, 1997, Lawson, 1997, Levine, 1997, Filipczak, 1996, Kelly, 1995, and Rothwell and Kazanas, 1994). And when discussing unstructured on-the-job training, Martin Broadwell, states that "ninety-five percent of all training that's done on the job is done so poorly that the job suffers measurably" (Filipczak, 1993, p. 30).

The second category of on-the-job training is structured on-the-job training, which is a planned and organized, one-on-one program designed to provide the employee with the knowledge and skills required to perform tasks entailed in the employee's job (Lawson, 1997). Structured on-the-job training provides the delivery of "training in an organized, sequential manner, with an eye toward becoming as efficient as possible" and to achieve new (higher) levels of efficiency in production (Barron, 1997, p. 14). Structured on-the-job training is defined as:

> "planned on-the-job training that occurs on the job and in real time. It is based on a job breakdown so that work requirements are systematically reviewed with newcomers (newly-hired workers or those who are new to a position or work duty) based on effective principles of instruction rather than the logic of the subject matter or the convenience or availability of the trainer" (Rothwell, 1997, p. 76).

Structured on-the-job training is based on adult learning theories and on how and why people learn. It takes into account several factors of learning: adults learn in different ways (e.g., visual, verbal, kinesthetic) and at different levels; adults learn best by doing and being actively engaged in what they are learning (e.g.,

just because the trainer told them how to do something, does not mean that the trainee has understood or developed the skill and is ready to apply it on their own); adult learning experiences need to be realistic for optimal transfer of learning; adults are motivated to learn what they need to know when they need to know it; and adults learn best in informal environments (Lawson, 1997). Structured on-the-job training provides for all of these trainee needs by using various teaching methods (e.g., lecture, demonstration, application, etc.); it allows the trainee to become actively involved in the training by performing the necessary skills; structured on-the-job training provides a real and practical environment because the learning process involves what the trainee will be required to perform on the job and it provides training on what the trainee needs to know right now. Incorporating adult learning theories, structured on-the-job training provides many advantages as a training technique. Nancy Chase, in the article "OJT Doesn't Mean 'Sit by Joe,'" offers several other benefits of structured on-the-job training: "it's inexpensive, quickly developed, takes place at the work site, and focuses on tasks that are directly related to the job" (Chase, 1997, p. 84).

Within the category of structured on-the-job training are four general types of on-the-job training: job instruction training (JIT), job rotation, coaching, and mentoring. Job instruction training was first developed during World War I by Charles Allen in order to train shipbuilders more systematically. JIT has since been used and includes the use of four specific procedures that trainers follow to train employees on their assigned jobs. JIT includes the following four steps:

1. Preparation, which is showing and demonstrating what the learners will do.
2. Presentation, which includes telling learners what they will perform and why.
3. Application, which is allowing the trainee the opportunity to practice the skills.
4. Inspection, which includes checking the trainee's work and providing feedback.

(Rothwell and Kazanas, 1994). The simplicity of this type of structure OJT is what distinguishes it from other types of OJT (DeSimone and Harris, 1998).

Job rotation is the second type of structured on-the-job training. "Rotation, as the term implies, involves a series of assignments to different positions or departments for a specified period of time" (DeSimone and Harris, 1998, p. 144). It is used to develop a working knowledge of various work areas, and the jobs that make up each work area. The trainee is evaluated by the trainer at each job, and at the end of training, the trainee's evaluations are used to determine which department and/or job the trainee will work (DeSimone and Harris, 1998).

Coaching and mentoring, which are very similar, are the final two types of structured on-the-job training. Coaching is distinguished from training in that the trainee must already possess the skills and knowledge of a job in order to be coached; the trainer shifts to the role of a coach after the trainee can demonstrate job skills. The coaches role is to facilitate learning and "guide learners toward the discovery of new knowledge or improved skills. The coach also seeks to influence learner attitudes by serving as a role model or mentor" (Sullivan, 1998, p. 6). Mentoring provides employees with a trainer who is usually a superior (manager or supervisor) "for the purpose of giving support,

helping the employee learn the ropes, and preparing the employee for increasing responsibility" (DeSimone and Harris, 1998, p. 145). Mentoring is also viewed as a learning relationship in which an individual with knowledge shares that knowledge with his or her partner (Woods and Cortada, 1998).

The Role of Checklists and Lesson Plans in On-the-Job Training

There are common elements that are necessary in a structured on-the-job training system Nancy Chase offers five basic necessities that are a part of a thoroughly planned, systematic, and consistent structured on-the-job training system. The author states that first, the trainer must analyze the needs and make a plan. The trainer must make a decision on whether training is the right solution for the problem, and if so, the trainer must decide on the goals, methods of evaluation, the trainer(s) and trainee(s), and what topics will be covered. Second, the trainer needs to develop a detailed task list, which includes performance/measurable objectives for each task (stating the intent, condition, and level of performance), along with standards of successful performance. Third, the trainer must develop job aids, which also include guidelines of performance, to assist in teaching the task. Fourth, the trainer should devise a training schedule in order to organize the on-the-job training and document who has and who has not been trained. Finally, a lesson plan must be developed to outline how the lesson will be taught, and what will be included. This is also important for consistency and accuracy (Chase, 1997). Several other experts support Chase's ideas, and also explain that the most important components of OJT include checklists with task lists and performance objectives, references, a

training schedule, and lesson plans (Levine, 1996, Kelly, 1995, Rothwell and Kazanas, 1994, and Wilson, 1990). These elements can be integrated into two specific training documents: training checklists and lesson plans. The training checklist integrates the task breakdown of a job, performance objectives, and standards of performance, while the lesson plan is a separate document that outlines the teaching methods, training time, and available resources (Rothwell and Kazanas, 1994).

Training checklists are used by peer trainers to stay on the right track during training, to document a trainee's progress in learning a job, and to keep training consistent and standard from trainee to trainee and trainer to trainer. Checklists are also used by supervisors to verify how well newly-hired employees are trained, and by trainees as job aids to recognize what they have and will learn in their job (Barron, 1997 and Filipczak, 1993). Checklists add structure to the training process: they list the specific skills that must be taught so "fewer tasks slip through the cracks and the employee is 'checked off' as each task is successfully performed" (Levine, 1997, p. 4). As training checklists integrate all of these components, once completed the checklists become proof that a trainee is able to perform a specific job to a certain performance level or standard (Levine, 1997).

Lesson plans are the other important document in a structured on-the-job training system. The purpose of the lesson plan is to give direction in the training and make it easier and more efficient for the trainer to instruct an employee (Broadwell, 1986). Broadwell also notes that the lesson plan (or outline, guide,

or trainer's notes as they are sometimes called) must include what the trainer will say, show, and do, what the trainee will be expected to do, a timeframe for training, and the job aids and resources that are used in training (Broadwell, 1996). Overall, the lesson plan is the "primary document that controls the quality of teaching" (Hennessy and Hennessy, 1989, p. 100).

An Example of a Structured On-the-Job Training Program

There are many examples of successful structured on-the-job training efforts in businesses. One such example is the structured on-the-job training system that was developed at Beoing Commercial Airplane Group. This example supports the benefits of using structure OJT, along with the elements that must be present in an OJT system. Boeing developed a "performance-based, hands on approach to developing, implementing, and evaluating a structured OJT program" called the Task Analytic Training System (TATS) (Walter, 1996, p. 23). The system uses three elements of structured on-the-job training: task analysis (the breakdown of a job into tasks and subtasks), job instruction training (a four step one-on-one training method that includes preparing the learner, presenting the information/tasks to the learner, the learner practicing the skill, and the trainer providing evaluation and feedback to the learner), and human factors principles (the use of teams to assist employees more effectively work with others and contribute to the organization).

TATS enlists the entire workforce into the development of the training system by creating specific teams: "a design team, an approval team, and a team facilitator" (Walter, 1996, p. 23). The facilitator is a non-expert in the work area in

which the training is being designed. The design team is made up of both subject matter experts and, at Boeing, many times there are trainees included in the design team to ensure that the training being developed is thorough enough for all groups of employees. The design team is responsible for the majority of the training design and development, including creating, implementing, and modifying the training. This team establishes measurable objectives for the training program, establishes approval of the training program, sequences the training, implements the program, and evaluates the effects of the training. The other team is the approval team, which is made up of technical experts and supervisors. This team is responsible for reviewing and approving all training programs (Walter, 1996).

Through the use of this structured OJT system, Boeing has found many benefits to the organization: increased quality of training, employee morale, and communication and decision making, along with employees who are trained in new skills very quickly (Walter, 1996).

Summary

By reviewing the literature and a similar research project related to structured on-the-job training, one finds that the development and use of training materials such as training checklists and lesson plans are two important features of an effective structure on-the-job training system.

Chapter 3

RESEARCH METHODS

Introduction

The problem of this study is to design and evaluate the benefits of training checklists and lesson plans in on-the-job training at Johnson Matthey Semiconductor Packages. On-the-job training is an important component in the operation of Johnson Matthey because it is used to ensure that employees are qualified and are performing jobs as efficiently as possible; however, on-the-job training has not always been the strongest link in the organization due to lack of time to train operators and insufficient training materials. In order to improve on-the-job training, the training system was revised by the researcher, along with others in the organization, and benefits of the changes were evaluated and documented by means of this research project. The objectives include determining a viable format and content for the documents, and evaluating the benefits of the training checklists and lesson plans as they are used at Johnson Matthey.

Chapter 3 includes information pertinent to the research methods. This chapter explains the research methodology and design that were selected. The chapter also discusses the sources of data, which include the population and samples. Finally, the data collection techniques that were used (how and when the data was collected) are explained.

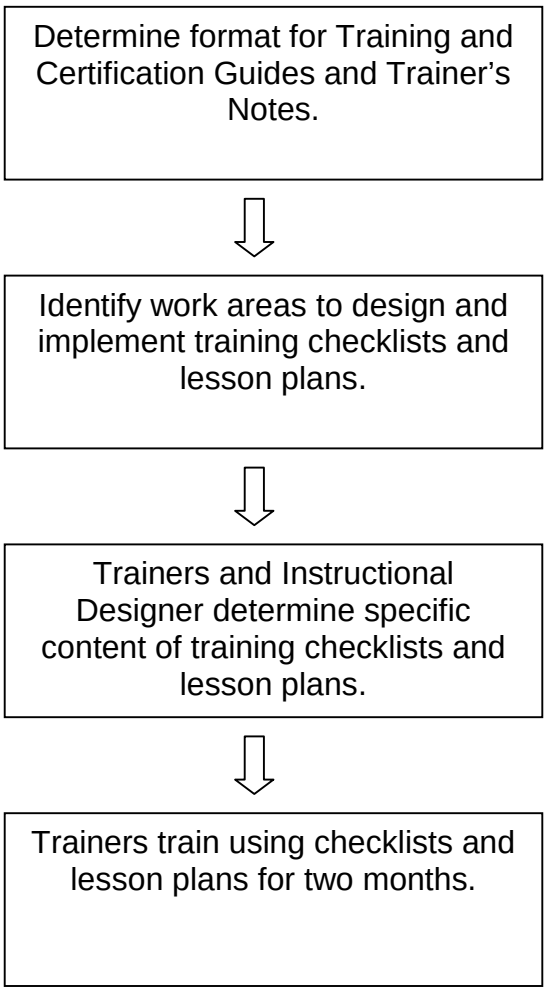
Research Methodology and Design

The research methodology that was used in this study was a descriptive study. To assist in this research, Johnson Matthey provided access to training records and participants (subjects). The descriptive study was conducted to determine and understand what the trainers and supervisors liked and disliked about the use of training checklists and lesson plans, along with how they perceived the use of the training documents to benefit on-the-job training. The descriptive study included surveys and interviews of the trainers and supervisors.

There were several steps involved in the design of this study (Refer to Figure 2). First, the format of the training documents (Training and Certification Guides and Trainer's Notes) was designed. Next, the participating work areas were determined. Third, the specific content for the Training and Certification Guide and Trainer's Notes was determined by the COTs and the instructional designer (researcher). Fourth, the COTs used the training materials for approximately two months. After these tasks were

completed, the researcher developed interview questions which related to the research objectives, and interviewed the supervisors of the three work areas. A survey was developed based on the supervisor's responses to the interview questions in order to acquire participants' ratings of the training materials. The researcher then surveyed all COTs and supervisors, and finally interviewed the trainers to discuss more in-depth the benefits and problems that they perceived of using and not using the checklists and lesson plans to assist in training.

Figure 2: Research Model



Sources of Data

The population of this study was the employees in the Soldermask, Automated Optical Inspection (AOI), and Electrical Test work areas at Johnson Matthey. The population size was approximately 120 employees. These three work areas were selected at the start of this research project because they had the time to dedicate to training, they were willing to participate, and the work area had trainers who were willing and available to participate as well.

It was also necessary to select this population for three main reasons: first, the population of the entire plant was too large to be able to research the entire population; second, not all employees are direct production employees and the study did not apply to those who are not involved in manufacturing; and most importantly, the three work areas

involved were the only ones with management (support) that was willing to invest the training time and efforts into participating in this study.

It is necessary to point out that the entire population of trainers and supervisors were "automatically" selected because they happened to work in the three participating work areas. Therefore, this study did not include any (random or other) sampling because the entire population of the trainers and supervisors in each work area were selected to participate.

Data Collection Techniques

The data needed for this study was the overall benefits of the use of training checklists and lesson plans. This included the likes and dislikes of the trainers and supervisors about the use and perceived benefits of the training documents.

The data that was collected, and the means to collect it, were valid and reliable: the survey and interview questions were written based on the objectives of this study. (The selected data relied on the objectives, so there was content validity.) The following questions were asked in the interviews:

1. What do you like and dislike about using the Training and Certification Guides and Trainer's Notes?

2. Do the Training and Certification Guides and Trainer's Notes adequately cover the questions that the trainer asks to check knowledge and skill when training? How? Give some examples.

3. Do the training materials help the trainee learn and accomplish what is expected of the trainee for each lesson? How?

4. Is the trainer's performance enhanced by using the Training and Certification Guide and Trainer's Notes? How?

5. What are the advantages to the trainer/trainee/company by using the Training and Certification Guides and Trainer's Notes?

6. What are the disadvantages to the trainer/trainee/company by using the training materials?

The limitations of this study were that the trainers had varying levels of training abilities and skills, as some have had more experience than others. Another limitation of this study was that it was only completed in the Soldermask, AOI, and Electrical Test work areas at Johnson Matthey, which is only three out of ten work areas at the company.

Chapter 4

RESULTS

Introduction

Chapter 4 explains the final design of the format and content of the Training and Certification Guide and Trainer's Notes. The chapter also describes the results of the use of the training materials, which includes an analysis of the survey and interview results. Finally, the benefits of using the training materials are identified.

Identification of the Format and Content of the Training Materials

The format of the Training and Certification Guides and Trainer's Notes were derived from the formats of checklists and lesson plans found in instructional design and on-the-job training resources, as discussed in Chapter 2, literature review, combined with format ideas of the researcher.

The Training and Certification Guide is a checklist for the Certified Operator Trainers (COTs), and more importantly for trainees, to use so they are aware of what they are expected to know and do for each job and to keep track of what has (and has not) been covered in training and certifying. The format of the Training and Certification Guide is organized in the following manner (Appendix C). The document is divided into sections which are the major topics that are covered in training and certifying. Each section is composed of three columns. The first column lists the tasks that make up each major topic. The second column contains the criteria that is required of the trainee to perform for each task. For each task and criteria, a performance objective is written. For example, in "Section 1: Handling and Cleanroom," the Training and Certification Guide states that (upon completion of the training,) without references, the trainee will demonstrate and explain the handling and gowning requirements with 100% accuracy. This objective must be met upon completion of training and in the certification process. The last column contains checkboxes which specify "trained" and "certified," and are checked at appropriate times in the training and certifying process. The COTs are instructed to check the "trained" boxes when they have covered each task and the applicable criteria. The purpose of this is so the COT and trainee can keep track of what has been covered, which is especially important when the trainers have more than one

trainee. The "certified" boxes are checked when the COT feels comfortable with the performance, knowledge, and skill of the trainee. Trainers are instructed that the trainee must complete each task according to the performance objective stated for each task; when this is achieved, the trainee may be certified.

In the Training and Certification Guide, the sections are grouped, and at the end of each group, there are spaces for the COT and trainee to sign and date. By the COT and trainee signing, they are both consenting that training has been completed for all tasks in each section and the criterion have been met. Following certification, the certifier (COT) signs at the end of each group, which signifies the trainee is capable of performing the tasks and has met all performance objectives in each section. The COTs are instructed to retain the Training and Certification Guide until the training and certifying is complete and the entire document is filled out and signed. It is then that they turn it into the training department to be filed.

The Trainer's Notes (lesson plan) contains a similar format as that of the Training and Certification Guide (Appendix D). The Trainer's Notes is also broken down into sections, which are the individual lessons. In each section (lesson), the tasks, which are also stated in the Training and Certification Guide, are listed in the first column. In the second column of each section, the performance objectives are stated, along with various methods for training/teaching to achieve each objective. The methods include ideas on preparing the trainee for each lesson, hints in how to demonstrate and present each task, when and how to allow the trainee to practice each task, and when and how to check the trainee's work and provide feedback. At the top of each section, an approximate training

time is stated, along with the resources that are necessary for the COT to gather prior to training each section.

The Training and Certification Guide and the Trainer's Notes are used together to outline the tasks and criterion of the tasks for each job, and to provide the training methods that can be used by the trainer to help the trainee accomplish the objectives and learn to perform each task.

The specific content of both the Training and Certification Guide and the Trainer's Notes was developed by the COTs with the assistance of the instructional designer. The instructional designer facilitated discussions that focused on the methods that COTs used to train each task, including tips and hints for training, the length of time that it took to train each section, and the resources that would be useful for training each tasks. The development and content of the documents were job-specific and vary per work area.

Results of the Use of the Training Materials

After the Training and Certification Guides and Trainer's Notes were developed by the COTs and instructional designer, the documents were used in each of the work areas for approximately two months. The supervisors of the selected work areas were then interviewed (Appendix F), and based on the interviews, surveys were developed for the supervisors and COTs to rate the training documents and their use (Appendix G). The responses to the interview questions by the supervisors led to the development of specific survey statements. Interview question one, led to the development of survey statements one, seven, eight, nine, and eleven; interview question two was used in survey statements two and six; survey statement two was also based on interview question three; interview question four was used to develop survey statements three, four, and ten; and interview question five was used to develop survey statements five, eight, and nine. Table 1 lists the statements that the participants were asked to rate.

Table 1 Survey Questions

1. **The training materials are easy for trainers to use.**
2. The training materials help the trainees achieve the learning objectives (to learn the tasks involved in a job).
3. The trainers better understand the learning objectives by helping to develop the training materials.
4. The trainer's (training) ability is improved by using the training materials.
5. The trainee's performance is improved by using the Training and Certification Guide as a checklist.
6. The training materials contain appropriate questions.
7. The training materials are thorough.
8. The current training materials are an improvement over what has been used in the past.
9. Training progress is easy to track using the training materials.
10. On-the-job training follows a logical sequence when using the training materials.

11. The quality of the training process is enhanced by using the training materials.

Table 1 lists the survey questions that were distributed to the participants.

After the surveys were completed by supervisors and trainers, the researcher interviewed the COTs to gather more information on the attitudes, ideas, and reactions of the COTs on the use of the training materials. The results of the interviews and surveys were then calculated and summarized (Appendix H).

A statistical analysis of the survey responses was completed and the results are shown in Table 2.

Table 2 Survey Results

Survey Question Number	Mean	Standard Deviation
1	4.25	.85
2	4.20	.41
3	4.65	.49
4	4.50	.61
5	4.25	.64
6	4.35	.59
7	4.45	.51
8	4.65	.67
9	4.30	.57
10	4.50	.61
11	4.55	.60

Table 2 presents the calculated results of the responses to the survey questions.

Because the mean of the survey questions was greater than 4.0, the results indicate that the respondents agreed with each of the survey statements, revealing that they liked using the training materials and felt that the materials were beneficial for the trainee and trainer to use. The standard deviation reveals that there were no wide ranges in the participants' rating responses, and in general, all participants rated the survey questions in a similar way.

Benefits of the Use of the Training Materials

The individual interviews yielded the benefits perceived by supervisors and COTs. In responding to the interview questions, the participants compared the training materials that were used in the past to the new training materials. There were seven main benefits that were discussed by the participants. The benefits, listed below, are those that were mentioned by at least three participants.

1. The training materials help make training consistent by outlining everything that must be accomplished and learned.
2. The materials outline all of the details and tasks necessary to train.
3. The training materials are easy for trainers to use and document what has been trained.
4. The trainee knows what is expected by referring to the tasks and criterion.
5. The materials are thorough and help make training consistent between trainers and for all trainees.

The other comments and benefits suggested by participants are listed in Appendix I.

Summary

The Training and Certification Guides and Trainer's Notes were documents that trainers and trainees found to be successful when using them in on-the-job training. Both the responses to the interviews and the ratings of the survey statements provide data that support the perceived benefits.

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This field problem studied the benefits of the use of training checklists and lesson plans in on-the-job training. Chapter 1 provided an introduction to the organization that the research was conducted, along with a statement of the problem and the objectives of the study. Chapter 2 described the history and research that has been conducted on on-the-job training, including the use of training checklists and lesson plans in on-the-job training. Chapters 3 and 4 specified the research methods that were used to collect data and the results of the research. Chapter 5 concludes with a summary of the research, provides a conclusion of the research project, and suggests recommendations for further research.

Review of the Research Methods

This descriptive study was conducted to determine and understand what the trainers and supervisors liked and disliked about the use of training checklists and lesson plans, along with how they perceived the use of the training documents to benefit on-the-job training. The descriptive study included surveys and interviews of the supervisors and trainers. The work areas were selected based on department management consent and included three of ten work areas at Johnson Matthey: Soldermask, AOI, and Electrical Test. In each of the participating work areas, all of the existing supervisors and

trainers were selected to participate in the study. After the materials were developed and used by the trainers for a period of two months, the supervisors were interviewed, surveys were developed based on the interview responses, and the trainers and supervisors were surveyed. After the data was collected, the results were analyzed to reveal the benefits perceived by supervisor and trainers.

Conclusions

The research project succeeded in meeting all of the requirements of the two objectives. The first objective of this study was to design a viable, generic format for training checklists and lesson plans that can be used in all work areas at Johnson Matthey. A viable and generic format was developed by the researcher by referring to resources that outline the necessary elements in training checklists, as discussed in Chapter 2. The format was also developed based on ideas of the researcher. The second objective of the study was to determine the content of the training checklists and lesson plans, which was accomplished by the COTs and researcher. In doing this, the researcher (instructional designer) facilitated discussion groups that determined what the specific content for each participating work area. The last objective of this study was to evaluate the benefits of training checklists and lesson plans when used in on-the-job training at Johnson Matthey. This was achieved by the researcher interviewing and surveying the supervisors and trainers to evaluate the benefits of the training materials.

Recommendations

The results of this study may be used to further develop and implement the training materials in other work areas; however, a study of the benefits in other work areas should be done in order to ensure that the materials are also appropriate for them.

Further research my be conducted through an experimental design in order to isolate the effects of the training materials. Other benefits of the materials may want to be researched like decreased training time (by comparing the training time before and after the use of the new training materials), decreased scrap rates of the trainees, and higher productivity levels of the trainees.

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Appendix A
TRAINING CHECKLIST PRIOR TO 1999

	Trainer Initial	Trainee Initial
1. SCOPE: Explain the purpose of this document.		
2. APPLICABLE DOCUMENTS: List, locate and explain applicable documents.		
3. TERMS AND DEFINITIONS: Define terms used and their definitions.		
4. SAFETY: Explain safety requirements.		
5. HANDLING: Demonstrate the correct handling methods.		

6. EQUIPMENT: Explain the equipment used.		
7. TOOLS:		
8. MATERIALS: List the materials needed to perform this operation.		
9. START-UP: Demonstrate/explain the start-up & start-up checklist.		
10. OPERATION: Demonstrate/explain the following		
11. QUALITY REQUIREMENTS: Explain quality requirements and why they are critical.		
12. SHUTDOWN: Demonstrate/explain a shutdown.		
13. MAINTENANCE: Demonstrate maintenance required of an operator and how it is recorded.		
14. TRAINING:		
15. TROUBLESHOOTING GUIDE / RFC's: Explain the RFC's.		

Trainer:_____/_____

Trainee_____/_____

Appendix B

CERTIFICATION CHECKLIST PRIOR TO 1999

Operator:_____ Date_____

Certified By:_____

Q. What information can you get from this process?
A. How to set up and run the machine____

Q. Why should you keep your hands and clothing away from the conveyor when its running?
A. To Avoid injury___

Q. Do you need to wear gloves?
A. YES___

Q. How do you handle the layers?
A. Edges___

Q. What clean room clothing do you need to wear?
A. Hair net, clean room shoes, and white smock___

Q. How do you set the speed?
A. Behind Door 1 is a Motor Control and a directional control switch, turn the dial ___ Turn the toggle switch to reverse__

Q. How do you set the air?
A. Regulator is located below the exit conveyor, set the air regulator to PSI___

Q. Where do you turn on the vacuum?
A. Red switch located on the north wall ___

Q. How do you place the material/layer on the conveyor?
A. Opposite corners, center on conveyor___

Q. What do you do for shut down?
A. Press the Red Button on the unit___ Flip vacuum to OFF position___

Appendix C

TRAINING AND CERTIFICATION GUIDE

Section 1: Handling and Cleanroom		
Task	**Criteria**	Trained Certified
Without references, the trainee will: 1. Demonstrate and explain the handling and gowning requirements.	*Complete with 100% accuracy:* 1. Complete the Module 5 AOI Handling Skills Checklist.	❑ ❑

Section 2: Introduction to the Verification Process		
Task	**Criteria**	Trained Certified
Without references, the trainee will: 1. Describe the Verification process. 2. Familiarize with various products and layers.	*Explain using key words and with 100% accuracy:* 1. All of the following: a. What the Verifier does to the product. b. How the Verifier works. 2. Locate all of the following: a. all types of current products b. print/etch layers c. ground layers d. via layers e. trace (wrap) layers	❑ ❑ ❑ ❑
Section 3: Defect Identification		
Task	**Criteria**	Trained Certified
Without references, the trainee will: 1. Identify defects. 2. Determine acceptable and unacceptable defects. 3. Identify/explain repeaters on layers.	*Identify and define with 100% accuracy:* 1. All of the defects in the Picture Defect Book. 2. All of the following: a. Use the Product Data Sheet Book, and/or Visual Defect Codes Book to determine acceptability of product to determine. b. Read the customer specifications that are on the job traveler. c. Who to contact if unsure about scrapping a panel. 3. All of the following: a. How to identify repeaters. b. What to do when find repeaters. 4. All of the following: a. Open b. Short c. Nick	❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑

4. Define and identify the applicable terms/defects.		

Trainee: _____ Date: _____/_____/_____

Trainer: _____ Date: _____/_____/_____

Certifier: _____ Date: _____/_____/_____

Appendix D
TRAINER'S NOTES

Section 1: Handling and Cleanroom	
Approximate Training Time: 2 Hours **Gather the Necessary Resources: Work Instructions AB-09.86 and AB-09.37, Handling Skills Checklist**	
Task	Training Method(s)
1. Demonstrate and explain the handling requirements.	**1. The trainee will demonstrate and explain the handling requirements with 100% accuracy according to the Handling Skills Checklist.** ✓ Prepare the Trainee: Overview of why we have Handling and Cleanroom requirements and what the general policies are. ✓ Train: Review all criteria included in the Handling Skills Checklist ✓ Practice: Allow trainee to practice two to three times. ✓ Evaluate and Provide feedback/corrections to trainee. ✓ Certify: Observe trainee follow all criteria included in the Handling Skills Checklist, and check off each section.
Section 2: Introduction	
Approximate Training Time: 2 Hours **Gather the Necessary Resources: Work Instructions DB-06.816 and DB-09.387 and PC User's Guide**	
Task	**Training Method(s)**
1. Describe the Verification process.	**1. The trainee will explain what the Verification process does to the product, using key words without the use of references.** ✓ Prepare the Trainee: Review the Introduction of the work instruction: stress key words and an appropriate description. ✓ Train: Show and explain the Verifier machine: point out the main

	parts of the equipment and how it works. ✓ Practice: Trainer explain how the machine works. ✓ Questioning: Ask the trainee questions about the machine: how it works and why it is used. ✓ Evaluate and Provide Feedback based on the responses of the trainee.
2. Explain the function of the machine's parts.	**2. The trainer will list the machine components and the trainee will be required to explain them with 100% accuracy without the use of references.** ✓ Prepare and train the trainee: Show and explain the Verifier's parts and the purpose of each part. ✓ Practice: Trainee identify the parts of the machine and explain how it works. ✓ Evaluate and Provide Feedback based on the responses of the trainee.

Section 3: Defect Identification

Approximate Training Time: 12 Hours
Gather the Necessary Resources: Work Instructions DB-06.816 and AB-09.387, Defect Picture Book, and Scrap Samples

Task	Training Method(s)
1. Identify defects.	**1. The trainee will identify all defects with 100% accuracy without the use of references.** ✓ Prepare the trainee: Explain what defects are, where they come from, and why it is important to repair defect or scrap parts as soon as possible. ✓ Train: Show defects in picture book and on actual scrap parts. ✓ Practice: Trainee identify defects in picture book and on scrap parts. Trainee complete correlation test. ✓ Feedback based on trainee identification of defects.

Appendix E
PERMISSION LETTER TO ALL PARTICIPANTS

Researcher:	Shannon M. Galindo
Research Project:	A study of the benefits of the use of Training and Certification Guides and Trainer's Notes in on-the-job training at Johnson Matthey.
Selection: you are a	You have been asked to participate in this study because member of one of three work areas selected to implement the revised training materials. The three work areas include: AOI (Verification and Repair), Soldermask (Coat, Print, Develop , Oven, and Screen Preparation), and Electrical Test (PDI and Raid).
Your Role:	If you choose to participate, the researcher will interview you to gather your ideas, reactions, and feelings about the use of the revised training materials.
Consent:	If you are willing to participate in this study, please read and sign the consent statement below.

I understand that participation in this study is strictly voluntary and I may discontinue my participation at any time without any prejudice. I understand the purpose of this study is to investigate on-the-job training. I further understand that any information about me that is collected during this study will be held in the strictest confidence and will not be a part of my permanent record. I understand that at the conclusion of this study all records which identify individual participants will be destroyed.

Signature of Participant: _____ Date: ____/____/____

NOTE: Questions or concerns about participation in the research or subsequent complaints should be addressed first to the researcher or research advisor and second to Dr. Ted Knous, Chair, UW-Stout Institutional Review Board for the Protection of Human Subjects in Research, 11 HH, UW-Stout, Menomonie, WI, 54751, phone (715) 232-1126.

Appendix F
INTERVIEW QUESTIONS

7. What do you like and dislike about using the Training and Certification Guides and Trainer's Notes?

8. Do the Training and Certification Guides and Trainer's Notes adequately cover the questions that the trainer asks to check knowledge and skill when training? How? Give some examples.

9. Do the training materials help the trainee learn and accomplish what is expected of the trainee for each lesson? How?

10. Is the trainer's performance enhanced by using the Training and Certification Guide and Trainer's Notes? How?

11. What are the advantages to the trainer/trainee/company by using the Training and Certification Guides and Trainer's Notes?

12. What are the disadvantages to the trainer/trainee/company by using the training materials?

Appendix G
SURVEY

Directions: Rate the following statements regarding the Training and Certification Guides and Trainer's Notes (training materials) that have been developed and used in your work area. Please be honest; your individual responses will not be shared with anyone, and the results will be used as a research tool only.

5 Strongly Agree
4 Agree
3 Neither Agree nor Disagree
2 Disagree
1 Strongly Disagree

12. The training materials are easy for trainers to use.	5	4	3	2	1
13. The training materials help the trainees achieve the learning objectives (to learn the tasks involved in the job).	5	4	3	2	1
14. The trainers better understand the learning objectives by helping to develop the training materials.	5	4	3	2	1

15. The trainer's (training) ability is improved by using the training materials.	5	4	3	2	1
16. The trainee's performance is improved by using the Training and Certification Guide as a checklist.	5	4	3	2	1
17. The training materials contain appropriate questions.	5	4	3	2	1
18. The training materials are thorough.	5	4	3	2	1
19. The current training materials are an improvement over what has been used in the past.	5	4	3	2	1
20. Training progress is easy to track using the training materials.	5	4	3	2	1
21. On-the-job training follows a logical sequence when using the training materials.	5	4	3	2	1
22. The quality of the training process is enhanced by using the training materials.	5	4	3	2	1

Appendix H
SURVEY RESULTS

Survey Question Number	Mean	Standard Deviation
1	4.25	.85
2	4.20	.41
3	4.65	.49
4	4.50	.61
5	4.25	.64
6	4.35	.59
7	4.45	.51
8	4.65	.67
9	4.30	.57
10	4.50	.61
11	4.55	.60

Appendix I
INTERVIEW SUMMARY

1. What do you like and dislike about using the Training and Certification Guides and Trainer's Notes?

LIKE:

- Simple, yet detailed.
- Training and certifying in one document makes it easy to find and keep track of.
- Covers everything that is required to know and do in a job; important tasks are identified and outlined.
- References and resources are identified.
- Trainer and trainee have to sign and date so as to consent that trainee occurred and that the trainee can perform the job.
- Logical sequence for training.
- Can see trainee's progress during the process of training; checkboxes to chart progress.
- Addresses different learning styles of trainees.

- Trainees know ahead of time what they must learn and will be tested on at the completion of training.
- Well-written and appropriate content.

DISLIKE:

- Trainer and trainee may not be clear on the correct way to use the documents.
- Trainer can check the boxes and sign, but may not care or make sure that training was thorough or that the trainee learned the skills/knowledge.

2. Do the Training and Certification Guides and Trainer's Notes adequately cover the questions that the trainer asks to check knowledge and skill when training? How? Give some examples.

YES

- Everything needed to know and do a job is listed as a task or criteria.
- Trainers and trainees more focused on the tasks that are listed to accomplish.
- Very thorough and covers everything.
- By the trainee having to actually perform the tasks and explain parts of the job, it ensures that the trainee is actually qualified to perform the job once training is complete.

3. Do the training materials help the trainee learn and accomplish what is expected of the trainee for each lesson? How?

YES

- Step-by-step so know exactly what need to know and do.
- Trainee knows what is expected of him or her based on the tasks and stated objectives.
- Covers entire process of training.
- Tells trainee what going to know and do when training is complete.

4. Is the trainer's performance enhanced by using the Training and Certification Guide and Trainer's Notes? How?

YES

- Trainers do not miss any steps in the jobs they train on; step-by-step and are easy to follow.
- Trainers can keep track of where they left off in training employees.
- Give trainers a plan to follow when training; a roadmap to the end result.
- Makes trainer's jobs easier, so then they are better.
- Materials go over the proper procedures for performing a job, so training is accurate.
- Reminds trainers of tips/hints they can use to train employees with different learning styles.
- Helps trainers be more organized.
- Consistent training, as each person is trained pretty much the same.
- Written references to follow.
- If trainer follows the documents, they tell trainer what and how to train from start to finish.

5. What are the advantages to the trainer/trainee/company by using the Training and Certification Guides and Trainer's Notes?
    - Make all groups responsible for learning and teaching jobs.
    - Trainee gets a sneak preview, along with something to focus on and strive to accomplish.
    - Enhances the quality of training by training being more thorough, trainers not missing or skipping anything, and all trainers following the same plan for training.
    - Better trained operators, better product and higher yields.
    - Sets expectations for trainer and trainee.
    - Standardizes training and operating machines (all do it the same way, or similarly).

6. What are the disadvantages to the trainer/trainee/company by using the training materials?

- IF the trainer does not use the documents accurately, and just checks off the boxes for whatever reasons (not ensuring that the trainee has learned the skills/knowledge), there are not advantages to the documents.