CONTENTS

Sustainability in High Reliability Organizations Employing Digitized Automation Inspection Processes ......................................................... 3
Constantine Koursaris

Effect of gamma irradiation on morphology and local elemental composition of basalt-based composite material ............................... 8
Vladimir Oniskiv, Valerii Stolbov, Elvira Ibragimova

The Use Carbon Composite Material for Replacement of Postresection Bone Defects ................................................................. 19
Nikolay Belokrylov, Aleksandr Sotin, Alexei Belokrylov, Tatiana Antipova

Observing the utilization of local e-commerce: a case study of a small and medium enterprise in Surabaya, Indonesia ...................... 32
Jessica Patty, Indrawati Yuhertiana

Cost-volume-profit analysis: practical aspects in e-commerce ............ 48
Darya Rozhkova, Nadezhda Rozhkova, Daniela Gonzalez Serna, Uliana Blinova

How innovation influence organisational performance among SMEs in Ghana: The mediating role of organisational leadership .......... 57
Esther Bentumaa Ofosu, Jerry Owusu Banahene, Kingsley Ofosu-Ampong
Sustainability in High Reliability Organizations Employing Digitized Automation Inspection Processes

Dr. Constantine M. Koursaris

Embry-Riddle Aeronautical University, Daytona Beach, US

https://doi.org/10.33847/2686-8296.5.2_1

Received 28.10.2023/Accepted 05.11.2023/Published 14.12.2023

Abstract. Digitization technologies offer several advantages over manual methods of accomplishing job-related tasks. Accurately measuring, documenting, and reporting surface damages, due to volume calculation variations are vital in increased efficiency, productivity, and thus mainly, human performance. Several sensation and perception issues were identified, mainly with concerns about accuracy of visual measurements that take place during quality control inspections. This research project portrays High Reliability Organizations utilizing digitized systems and automation concepts, with emphasis in Sensation, Perception, and Human Performance. Problem areas in measuring and assessing damaged Thermal Protection System (TPS) tile surfaces are identified and documented. Analysis of performance issues, causes, and effects, of human error factors are analyzed.

Keywords: Digitization, Digital, Science, Technology, Engineering, Laser Scanner.

1. INTRODUCTION

In early 2000, the use of emerging digitization technology methods, were used to assess and report problems in the analysis of damaged tile surfaces with accuracy, efficiency, increased productivity, and performance. From a human performance, sensation, and perception points of view, a newly developed digitized system would eliminate the need of performing manually cumbersome and arduous calculations.

The result of this research project was the adoption of an operational digitized system as the set standard of the time, for efficiently assessing and analyzing surface damages during various stages of quality control inspections. The human-machine interaction is a very strong issue that human factors experts strive to understand with as much detail as possible. Understanding the modeling of human information processing and human performance is another key factor in applying new knowledge gained thus enriching the knowledge, in improving human-machine interactions. "Many human-machine systems do not work as well because they impose requirements on the human user, that are incompatible with the way people attend, perceive, think, remember, decide, and act, that is, the way in which people perform or process information [1]. The sensation and perception factors are related to how the brain works, rationalizes, and the feeling created by perception when a new system is introduced into the workforce. The processes that take place in the brain and the senses play a key factor in forming our own perceptual experiences especially if the new system is supported by Management directive within the organization. The main human senses that are "put to the test", are performed with tactile and visual senses, a hands-on type of work, performed by the quality control inspectors.

This digitization technology research project was a real-world application that brought together engineers, scientists, human factors experts, and users, from NASA, several contractors, and inter-departmental participation.
2. BACKGROUND

A main concern of the project team was the impact on the quality control (QC) inspectors to produce accurate problem reporting and corrective action based on the resulting scanned measurements. Situation awareness was a big factor due to the effects that that situation awareness played on the QC inspectors required to be on alert at all times. Not only safety was a major concern, like for example, slips and falls, but also the level of alertness was critical while taking the measurements and recording them on the problem reporting corrective action form, and transferring the recorded measurements onto the digitized form to be processed for corrective action. With that being said, there was little room left for any type of error, as the slightest miscalculation could result in a very costly repair.

The risk of making the wrong decision by the quality control inspectors was always a cautionary topic of concern. Prior to the electronic inspection tool implementation, a team of two quality control inspectors would be assigned the task to verify and validate the accuracy of damaged surface area tile measurements performed by another team of QC inspectors. The measuring of the length, width, and depth calculations were inefficient with the manual process, and often resulted in wrong calculations and analysis of surface damages. Due to the fact that the QC inspectors were required to document the problem reporting and corrective action forms, manually was the standard operating procedure, resulting in wasteful human performance by having to repeat the process when entering the data in the computerized electronic forms. Recording inaccurate information often resulted in the wrong decision being made to order replacement parts, or repair surface damages, as needed. The result was degradation of human performance, wasted employee productivity, and efficiency.

3. METHODOLOGY

Verifying and validating accurate volume measurements of damaged surfaces are essential decision-making determining processes against standardized specifications, performing a corrective action as a discrepancy that had to be either repaired, or replaced. One advantage of using digitized technologies as opposed to manual processes, is, also the implementation of the use of ergonomic tools to accomplish a set task.

The digitized tool should be capable of capturing the data and by multiplying the length, width, and depth measurements quality inspectors were able to populate the volume field on the graphical user interface, (GUI) with high level programming language calculations using Visual Basic [7]. This process involved capturing all the relevant data from the database, parse the data, and populate all of the necessary fields and information on the electronic version of the problem reporting and corrective action (PRACA) form for formal order processing of the damaged tiles [3]. Any relevant notes on the problem reporting or discrepancies were also noted and printed on the PRACA form.

4. RESULTS

The digitized tool became commonly known as the Electronic Inspection Tool (EIT) among the team members and officially referred to as the MOLD IMRESSION LAZER TOOL (MILT). Early versions of the tool were made with monochromatic grayscale shades and wired USB connection. [5].

©ICS. Journal of Digital Science, ISSN 2686-8296, Vol.5, Iss. 2, December 2023
Fig. 1 portrays the initial model of the Electronic Inspection Tool, connected to a laptop via a wired USB cable, with the ability to transmit captured data into a temporary storage location on the laptop hard drive. Once the laptop was connected to the network, it was possible to invoke a transfer command which in turn transferred the calculated data into the distributed database for permanent storage and retrieval.

Fig. 2 illustrates a quality control inspector using the first draft model of the Electronic Inspection Tool [4]. Notice the USB cable that connects the MILT to the laptop which is resting on the floor of the flat stand ladder that the QC inspector is standing on and raised to an appropriate height to reach the underneath the damaged surface.

The updated revision of the Electronic Inspection Tool, as shown in Fig. 2, included the design of a wireless 3D scanner that used the same software developed to store the scanned data and process the volume damage area. The scanning process took approximately 5 seconds to complete. Scanning the damaged area produced and displayed the results in a 3D image on the laptop. The QC inspectors would have the opportunity to review the damaged area in 3-D as it was portrayed on the laptop screen. Figure 3 shows the newly designed wireless scanner in action [3]. Notice the improvement from the first model discussed previously. The colored image of the scanned tile damages matches the trichromatic theory of color vision.
Contrasting the scanned damaged tile from the initial model of the Electronic Inspection Tool is shown in Figure 4, it is evident, the damaged trichromatic color images on the right, are clearly visually perceived, compared to the grayscale image on the left. This gives the QC inspectors a much clearer sense of perception, in terms of length, width, and depth damages of the tile area scanned when magnified, in the analysis of results. We can clearly see that the trichromatic theory holds in this case, as the clarity of the color vision is illustrated [1].

As a result of the research performed and implementation of EIT, NASA developed the Surface Inspection Tool, to perform real-time, visual inspections for optical detection of damaged orbiter widow surfaces [7].

5. CONCLUSION

This research encompassed the use of Systems Automation concepts with emphasis in Sensation, Perception, and Human Performance. The digitized designed system increased the performance of the quality control inspectors inaccurately assessing damaged volume surfaces. Several factors that impact sensation and perception were discussed. The previous state of the system prior to the design of the new system established several key issues that related to sensation, perception, and human performance.
These key issues were identified as problem areas and were tasked to be solved as the goals of accomplishing the newly designed EIT project successfully. Hindrance of performance by manually calculating surface damages identified causes of human error factors when fatigue and duplication errors occur. The justification for the need analysis for a new digitized technology process became evident. The newly designed automated system in early 2000, was years ahead of its time by far, and improvements made from a sensation, perception, and human performance standpoints were notable feats of accomplishment for its time period. The implementation of the Electronic Inspection Tool solved the lengthy manual problems reported by the quality control inspectors. The implementation of EIT improved many human factors issues the Quality Control inspectors were facing, that proved to be a very reliable method to measure, assess, report, and analyze damaged tile surface areas so that the correct decisions could be made to repair or replace damaged tiles. Increased productivity was realized immediately, with the more reliable scanned results, proved to be accurate to within one thousandth of an inch. Efficiency was a big accomplishment as the newly designed method enabled the QC inspectors to complete their measurements in about 5 seconds or less, compared to the manual process that took several minutes to complete. In turn, employee productivity increased with the ability to do more by completing their assigned measurements analysis with considerably less time than the previous process. In this case, automation was unanimously embraced by all stakeholders of the EIT project, putting an end to the cumbersome and inaccurate method of the manual measuring process.

The EIT team was nominated to win several innovation and invention awards. Several other EIT nominations were awarded that were instrumental in accurately measuring damaged surfaces.

ACKNOWLEDGMENTS

This research paper was partially supported by a grant from Embry-Riddle Aeronautical University.

REFERENCES

Aims and Objectives
Published online by Institute of Cited Scientists, Cyprus, two times a year, Journal of Digital Science (JDS) is an international peer-reviewed journal which aims at the latest ideas, innovations, trends, experiences and concerns in the field of digital science covering all areas of the scholarly literature of the sciences, social sciences and arts & humanities. The main topics currently covered include: Digital Economics, Education, Engineering, Finance, Health Care.

The main goal of this journal is the effective dissemination of original incites/results generated by the human brain and presented/reflected in articles using modern information/digital technology.

This current issue mainly consists of selected paper presented on the International Conference on Digital Science (DSIC 2023) that was held on October 20-22, 2023 in Agia Napa, Cyprus and divided on two equal parts: 1. Engineering scientific view (the first three articles) and 2. Economics scientific view (the last three articles) with multidisciplinary approach on adoption of Digital technology/knowledge in modern reality.

Editorial Board

Editor-in-Chief  Tatiana Antipova, Institute of Cited Scientists, Cyprus; https://orcid.org/0000-0002-0872-4965

Associate Editor Julia Belyasova, Catholic University of Louvain, Louvain-la-Neuve, Belgium; https://orcid.org/0000-0001-6983-2129

Editors

Abdulsatar Sultan, Catholic University in Erbil, Erbil, Iraq; https://orcid.org/0000-0001-5090-5332
Achmad Nurmandi, Universitas Muhammadiyah Yogyakarta, Indonesia; https://orcid.org/0000-0002-6730-0273
Jelena Jovanovic, University of Nis, Nis, Serbia; https://orcid.org/0000-0001-7238-6393
Indra Bastian, Universitas Gadjah Mada, Yogyakarta, Indonesia; https://orcid.org/0000-0003-4658-8690
Indrawati Yuhertiana, Universitas Pembangunan Nasional Veteran Jatim, Surabaya, Indonesia; https://orcid.org/0000-0002-1613-1692
Lucas Tomczyk, Uniwersytet Jagielloński, Krakow, Poland; https://orcid.org/0000-0002-5652-1433
Narcisa Roxana Moșteanu, American University of Malta, Bormla, Malta; https://orcid.org/0000-0001-5905-8600
Olga Khlynova, Russian Academy of Science, Moscow, Russia; https://orcid.org/0000-0003-4860-0112
Omar Leonel Loaiza Jara, Universidad Peruana Unión, Lima, Peru; https://orcid.org/0000-0002-3262-709X
Roland Moraru, University of Petrosani, Romania; https://orcid.org/0000-0001-8629-8394
Tjerk Budding, Vrije Universiteit Amsterdam, Netherland; https://orcid.org/0000-0002-5343-7535
Quang Vinh Dang, Industrial University, Ho Chi Minh City, Viet Nam https://orcid.org/0000-0002-3877-8024

Contact information

Journal URL: https://ics.events/journal-of-digital-science/
Email: conf@ics.events
Printed online from the original layout under the imprint at: 1, Vlachou, Nicosia, The Republic of Cyprus

©ICS. Journal of Digital Science, ISSN 2686-8296, Vol.5, Iss. 2, December 2023