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Preface: The 6th Engineering Science and Technology International Conferences 2021 (ESTIC 2021)

The 6th Engineering Science and Technology International Conference 2021 (ESTIC 2021) was held in Padang, West Sumatra, Indonesia from 27 October 2021. The conference was organized by Universitas Bung Hatta (UBH) and attended by academics, practitioners, researchers, postgraduates from Indonesia and several countries around the world.

In continuity from the implementation of ESTIC 2018 and ESTIC 2020, the conference is again an international platform that allows researchers, academics, and industry experts to share and discuss their latest research, ideas, and reports in theoretical and practical fields regarding all aspects of Technology and Applied Sciences. All submissions to the conference have gone through a reviewer review process by at least two independent peers. This conference provides an opportunity for readers to engage with a selection of papers that have been presented during the ESTIC 2021 conference.

73 contributors from local and international academics, Government and private institutions who contributed papers in Electrical Engineering, Mechanical Engineering, Chemical Engineering, Industrial Engineering, Civil Engineering, Information Communication and Technology (ICT), Computer Science, Materials Science, Engineering, Environment, and other interrelated fields have truly made this conference a unique platform for the exchange of interdisciplinary ideas among participants. Of all papers received, 49 have passed the academic peer review process and are included in the submission. An integral part of ESTIC's success 2021 is the hard work and perseverance of technical committee members, scientific committee members, our esteemed reviewers from an extensive list of universities around the world and also strong support from members of the Institute for Research and Community Service (LPPM). We would like to express our sincere gratitude to these extraordinary people for making ESTIC'2021 a success.

ESTIC 2021 participants are able to engage in great opportunities for presentation and academic discourse, which has strengthened collaboration between science and technology in academic and industrial fields that have been developed in previous conferences. Representatives from industry, academia and government research and development, professional practice, business, and management in the fields of science, and technology have become part of ESTIC 2021.

A conference that encourages and enables knowledge sharing and collaboration opportunities must be developed and maintained as it produces a wide variety of areas of knowledge that can be applied in the development of new ideas and technologies. We look forward to the exciting moments of the 7th Engineering Science and Technology International Conference (ESTIC 2022) in Bukittinggi, West Sumatra Indonesia next year.

Burmawi, Maria Ulfah, Mulyanef, Dessi Mufti, Yesmizarti Muchtiar, Budi Sunaryo[1]

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PRELIMINARY

Preface: The 6th Engineering Science and Technology International Conferences 2021 (ESTIC 2021)

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ARCHITECTURE

Study identification of landscape elements in the Bandung Ganesha garden environment

Tita Cardiah; Andiyan; Syahban Rangkuti; Eliyana Firmansyah

AIP Conf. Proc. 2691, 020001 (2023) https://doi.org/10.1063/5.0114926

Abstract View article PDF

CIVIL ENGINEERING

Utilization of hydrodynamic models for development of the coastal zone in Poso Regency

Surya Hermawan; Angela Jasmine Tanya Tjahyana; Ansell Alvern Tobing; Reddy Viriya Suwarno; David S. V. L. Bangguna; Ifiginia

AIP Conf. Proc. 2691, 030001 (2023) https://doi.org/10.1063/5.0118448

Abstract | View article | PDF

The comparison of Brackish water treatment using local filter materials and reverse osmosis filters

Surya Hermawan; Angela Jasmine Tanya Tjahyana; Peni Tiewanto; Ivan Richardian Limantara; Ivan Reynaldi Limantara; Kiki Prio Utomo; Nelly Wahyuni

AIP Conf. Proc. 2691, 030002 (2023) https://doi.org/10.1063/5.0118445

Abstract | View article | PDF

Waste material analysis for BoQ control on structural work using Building Information Modeling (BIM)

Hari Purwanto; Siti Ramadinayanti; Muhammad Fathur Rouf Hasan

AIP Conf. Proc. 2691, 030003 (2023) https://doi.org/10.1063/5.0115065

Abstract | View article | PDF

Cost calculation comparison of wall finishing work on project X between conventional method and BIM method

Nunung Martina; Diti Iftitah Anggraeni; Muhammad Fathur Rouf Hasan

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Abstract View article PDF

Factors causing rework on building construction projects in Aceh province, Indonesia

Tata Miralda; Muttaqin Hasan; Yunita Idris

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Infiltration wells for various house types in the Kuranji catchment area, Padang City

Zufrimar, Edwina Zainal

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Abstract View article PDF

Prediction of availability water supply based on area and volume changes of Alluvial sediment at river intake

Putera Agung Maha Agung; Muhammad Fathur Rouf Hasan

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Seismic performance of special steel moment resisting frame building with consideration of setback irregularities

Ridho Aidil Fitrah; Masrilayanti

AIP Conf. Proc. 2691, 030008 (2023) https://doi.org/10.1063/5.0114899

Abstract View article PDF

Brackish water treatment in Sidoarjo area (East Java Indonesia) using Reverse Osmosis (RO)

Surya Hermawan; Angela Jasmine Tanya Tjahyana; Kiki Prio Utomo; Nelly Wahyuni; Peni Tiewanto; Ivan Richardian Limantara; Dicky Huidiyanto

AIP Conf. Proc. 2691, 030009 (2023) https://doi.org/10.1063/5.0118443

Abstract View article PDF

Designing educational facilities that outrun railways to be inclusive, safe, resilient, and sustainable

Surya Hermawan; Vanessa Nathania Husada; Vania Regina Husada; William Alfred

AIP Conf. Proc. 2691, 030010 (2023) https://doi.org/10.1063/5.0118444

Abstract View article PDF

Utilization of the hydrodynamic model to determine the movement characteristics of marine debris in Karimata islands compare to data collection from citizen science research

Surya Hermawan; Angela Jasmine; Theo Lorenzo Senjaya; Wilson Saputra; Kiki Prio Utomo; Yoga Budihandoko

AIP Conf. Proc. 2691, 030011 (2023) https://doi.org/10.1063/5.0118449

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Project time performance: Is technology relevant?

Bahrul Anif; Henike Sari; Rini Mulyani; Wahyudi P. Utama; Desi Ilona; Zaitul

AIP Conf. Proc. 2691, 030012 (2023) https://doi.org/10.1063/5.0114900

Abstract View article PDF

MECHANICAL ENGINEERING

Analisys of mechanical properties of AISI 4140 with heat treatment tempering

Burmawi; Kaidir; M. Ulfah; Rifky Syafri

AIP Conf. Proc. 2691, 040001 (2023) https://doi.org/10.1063/5.0116093

Abstract View article PDF

Improving the perception of preventive maintenance: Contextual-based collaborative learning model for mechanical engineering students

Wenny Marthiana; Jalius Jama; Ridwan; Edi Septe; Suryadimal

AIP Conf. Proc. 2691, 040002 (2023) https://doi.org/10.1063/5.0115506

Abstract View article PDF

The effect of tin electroplating current density on steel plate in zinc chloride solutions

Edi Septe; Refdinal; Yovial Mahjoedin; Wenny Marthiana

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Abstract View article PDF

The adsorption ability of Cacao peels extract in protecting corrosion rates on steel surfaces

Yuli Yetri; Gunawarman; Rakiman; Adri Yanti Rivai

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Performance of greenhouse type solar still on fresh water productivity

Mulyanef; Duskiardi; Kaidir; K. Sopian; L. Aples

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Abstract View article PDF

Stress analysis of waveguide with two layers of material polyester – Chitosan using finite element method

Ojo Kurdi; Rusnaldy; Djoeli Satrijo; Susilo Adi Widyanto; Ian Yulianti; Risavel Abelardo Hutagalung

AIP Conf. Proc. 2691, 040006 (2023) https://doi.org/10.1063/5.0115905

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Mechanical properties of kenaf Fiber/epoxy bio-composit

Hendra Suherman; Kamdini Aksa; Iman Satria; Duskiardi Duskiardi; Irmayani Irmayani

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Abstract View article PDF

Performance study of air conditioning system using solar power photovoltaic as energy source

Kaidir; Suryadimal; A. Wibisono; Burmawi; Mulyanef

AIP Conf. Proc. 2691, 040008 (2023) https://doi.org/10.1063/5.0116636

Abstract View article PDF

Vibration testing to determine charateristics of dynamic response on the aluminium-beam

Rizky Arman; Zainal Abidin; Burmawi; Yovial Mahyoeddin; Wenny Marthiana

AIP Conf. Proc. 2691, 040009 (2023) https://doi.org/10.1063/5.0115029

Abstract View article PDF

Rheological study of electrical conducting composites for injection molding feedstock

Yovial; Edi Septe; Ija Darmana; Dessi Mufti; Yos Nofendri

AIP Conf. Proc. 2691, 040010 (2023) https://doi.org/10.1063/5.0116010

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CHEMICAL ENGINEERING

Effect of temperature on pyrolysis liquid fuel generated from polypropylene plastic waste

Erda Rahmilaila Desfitri; Munas Martynis; Erti Praputri

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Abstract View article PDF

Synthesis and characterization of a zeolite pellet using natural Kaolinite clays from Indonesia as binder and their application in dehydration ethanol

Maria Ulfah; Erti Praputri; Firdaus; Yesmizarti Muchtiar; Burmawi

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Evaluation of pre-purification extractors of catechin isolation from community Gambier (*Uncaria Gambiere Roxb)*

Ellyta Sari; Elly Desni Rahman; Burmawi; Natassya Athiya Salsabila

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Abstract View article PDF

Radiocesium distribution in the sediments and surface seawater in the South Java sea, Indonesia

Murdahayu Makmur; Untara; Wahyu Retno Prihatiningsih; Mohamad N × Yahya; Deddy Irawan Permana Putra; Yogi Priasetyono

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Composting of kitchen waste by Takakura method using local microorganism activator from coconut husk waste and vegetable waste

Rizki Aziz; Yommi Dewilda; Mita Afriyanif

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ELECTRICAL ENGINEERING

Effect of harmonic distortion on distribution feeder losses serving housing load

I. Nisja; Surya Hardi; R. F. Armen; M. Irwanto; Yani Ridal; Arzul

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Ija Darmana; Stesa Berliana; Erliwati; Adiv Rama Salvayer

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Comparative study of static var compensator and capacitor bank for increasing transmission lines performance

Muadzzah Rahmat; Indra Nisja; Surya Hardi

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Abstract View article PDF

The maximum power point tracking (MPPT) on changes in radiation and temperature of solar modules based on fuzzy logic controller (FLC)

Teuku Murisal Asyadi; Muliadi

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Abstract View article PDF

Effect of two-layer soil model on the design of substation grounding system

Surya Hardi; Suherman; Nurhafni Carol; R. Harahap

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Abstract View article PDF

Analysis of soil resistivity improvement with variations of bentonite and chemical for grounding of electrical equipment

Surya Hardi; Milli Alfhi Syari; Emerson P. Sinulingga

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Abstract View article PDF

INDUSTRIAL ENGINEERING

Quality management in R&D organization: Critical success factors

Nidya Astrini; I. Gede Mahatma Yuda Bakti; Medi Yarmen; Rahmi Kartika Jati; Sih Damayanti; Sik Sumaedi; Tri Rakhmawati; Tri Widianti

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The influence of order process and transportation on the quality of service: Case study at Sharia-compliant hotel

Danny Alfiando; Jundi Nourfateha Elquthb; Qurtubi; Ira Promasanti Rachmadewi

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Discovering the value of news: Evidence from the stock market

Mei Yang; Du Ni; Yingchi Qu; Zhi Xiao

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Analysis of housing project scheduling using Critical Path Method (CPM)

Noviyarsi; M. Nursyaifi Yulius; Eltira Mutiara

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Abstract View article PDF

Analysis of the defect level reduction on bottle cap using Six-Sigma

Rahmad Husaini; Melinska Ayu Febrianti; Qurtubi; Vembri Noor Helia; Ira Promasanti Rachmadewi

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Suppliers selection using analytical hierarchy process method (Case study: CV. pasaman perabot)

Irmayani; Hary Fandeli; Mufrida Meri; Abdullah Effendi

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Abstract View article PDF

Solid waste management strategy for settlement on a sloping hilly area of Padang city, Indonesia

Rizki Aziz; Melinda Noer; Arif Nurman

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Abstract View article PDF

Motorcycle helmet evaluation by Kansei engineering methodology

Kezia Admadiredja; Ari Widyanti

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Abstract View article PDF

COMPUTER ENGINEERING

Computerized framework for assessment of OBE in Bung Hatta University

Zulfadli; Arnita; Budi Sunaryo; Riska Amelia; Dara Novtah Eka Sukma

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Abstract View article PDF

Tracking technology for tourist behavior

Budi Sunaryo; Jack Febrian Rusdi; Sazilah Salam; Nur Azman Abu; Muhamad Sabar; Nova Agustina

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Monitoring location of people in a certain area using Wi-Fi

Marvin Chandra Wijaya

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Abstract View article PDF

Journalist system using named entity recognition based on Twitter location extraction

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Customer clustering using K-means clustering: Supporting customer relationship management system

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RESEARCH ARTICLE | JUNE 01 2023

Project time performance: Is technology relevant?

Bahrul Anif; Henike Sari; Rini Mulyani; ... et. al

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Project Time Performance: Is Technology Relevant?

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Abstract. This research focuses on the low performance of the contractor in achieving the time target set for the completion of road construction projects in Solok Regency. The United Economic and Social Commission for Asia and the Pacific (UNESCAP 1989) in the Technology Atlas Project defined technology as the combination of four components dynamically integrated into the transformation process of construction project implementation. However, there are limited studies on the effect of technological aspects, including techno-ware, human-ware, info-ware, and organ-ware, on project time performance, which is the focus of this present research. This study was conducted using a total of 100 respondents, and the data collected were analyzed using multiple linear regression analysis. The results showed that the significant technology factors affecting the performance of the project implementation time are human-ware (α=0.14) and organ-ware (α=0.08). The practical and theoretical implications of this finding are comprehensively discussed in the conclusions and suggestions section.

INTRODUCTION

Project implementation time performance is an indicator used in determining the achievement level of a project based on the time dimension. It is also used to compare the time from when the contractor has received the Work Start Order to the progress recorded in the field with the predetermined timeframe and deadline stated in the contract [1]. Moreover, time management in construction projects is defined as the schedule designed to monitor the activities' implementation according to the stipulated time. It involves referring to all the stages, their duration, and the resources. Previous data and information also showed the scheduling process is needed to ensure adequate output for the progress indicators. Time performance has been discovered to positively affect when the work is initiated immediately after the contract has been agreed. The actual progress was observed to be practically faster than the plan, and the result is expected to be completed before the deadline [2].

The low management ability of the contractor causes project delays. For example, the data from the Solok Regency agency sector showed three packages of activities were delayed in 2017, 3 packages in 2018, and 4 packages in 2019, with several factors, reported to have been the reason, including the financial aspects [3], [4], lack of communication [5], design engineer [6], clients [7], and project type [8]. There are, however, limited studies conducted to examine time performance or project delays from the technological aspect. However, a study using technology have been documented in Indonesia [9]–[15]. Meanwhile, technology is generally believed to have the capacity to improve organizational performance and competitive advantage due to its ability to create certain barriers for competitors. It has been reported to be an excellent competition driver even though not all technological changes provide strategic advantages for construction companies [16].

The United Economic and Social Commission for Asia and the Pacific (UNESCAP 1989) in the Technology Atlas Project defined technology from the production context as a combination of four components dynamically integrated into a transformation process. These four components include the engineering facilities known as techno-ware, human

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resources known as human-ware, the information described as info-ware, and the organization explained as organ-ware. These are usually prioritized in a construction company to manage a project activity and are considered inseparable. The techno-ware acts as the core of the transformation system built, prepared, and operated by the human-ware. Moreover, the human-ware is a key element that uses info-ware to perform certain transformation operations such as making decisions and operating techno-ware. At the same time, the organ-ware directs and controls info-ware, human-ware, and techno-ware in conducting the transformation operations [17].

The techno-ware is related to the non-optimal management of project resources by the contractor, while the human-ware factor includes the managers and personnel with minimal quality and experience assigned by contracting companies. Meanwhile, info-ware is believed to be caused by the inadequate implementation of the information guidelines related to technical specifications of materials and equipment by the contractor. Organ-ware involves the relatively low cooperation, communication, and coordination between personnel, leading to the non-optimal supervision, inspection, and control of the work done by the workers and suppliers. Some of these, therefore, trigger the slow achievement of actual progress and consequently delay project completion. This background information shows the importance of examining the effect of these four technology components on project time performance. This is the focus of this present research and the determination of why time performance varies from one project to another. The findings are expected to be useful for construction industry stakeholders and enrich the body of knowledge on project time performance and project delays. This study is divided into four parts: introduction, research methods, results and discussion, and conclusions and suggestions.

METHOD AND MATERIAL

This research consisted of construction industry stakeholders in Solok City, and 110 were selected as samples using the census method. Moreover, primary data were collected through surveys focusing on two types of variables, including the time performance used as the dependent variable and techno-ware, human-ware, info-ware, and organ-ware used as the independent variables. The time performance variable had three items while techno-ware had 11 items, human-ware had five items, info-ware had three items, and organ-ware had seven items. The technology variables were adopted from [16] and have been validated by experts. Furthermore, the variables were measured using a 5 Likert scale starting from strongly disagree to agree strongly, while the data obtained from the survey were analyzed using multiple linear regression with the following model:

$$KW=\alpha + \beta_1 TECH + \beta_2\ HUM + \beta_3\ INF + \beta_3\ ORG + \mu$$

Where,

KW	: time performance
TECH	: techno-ware
HUM	: human-ware
INF	: info-ware
ORG	: organ-ware
α	: constant
β	: regression coefficient
μ	: error

It is important to note that the research instrument was tested for validity and reliability before the regression analysis [18]. The validity test was conducted using a loading factor test after KMO and Bartlett tests have been completed [19], [20], while the reliability test was through the Cronbach alpha test [21] with a minimum value of 0.60 [22]. These were followed by the classical assumption test for normality, multicollinearity, and heteroscedasticity [23]. Meanwhile, the effect of the independent variable on the dependent variable was analyzed using a significant value or t-statistics [18] such that the relevant variable is considered to have a significant impact when the significant value is less than 0.10, which is the largest.

RESULTS

A total of 110 questionnaires were distributed, with 102 returned and 100, which make up 90.9%, were processed. The higher percentage of the respondents was between 31-40 years old as represented by 35%, followed by 41-50 years old with 34%, while most of them, 29%, were reported to have 6-10 years of work experience. Moreover, 18%

were found to be implementers while 17% are contractor engineering staff, and their highest level of education was recorded to be graduates from undergraduate studies with 53%. Meanwhile, most of the stakeholders represented by 45% were contractors.

The results of the validity and reliability tests conducted are shown in Tables 1 to 5, and the techno-ware variable was recorded in Table 1 to have a KMO value of 0.69 (Bartlett, 1950; Kaiser, 1970) and a loading factor of 0.50 [18]. The validity test also showed that techno-ware items including tec 1, tec 2, tec 3, tec 5, tec 7, and tec eight are valid, and the reliability test indicates the variable is reliable due to its Cronbach alpha value which is greater than 0.60 [22].

TABLE 1. Validity and reliability test results for techno-ware

Variable	Item	Loading Factor	KMO	Cronbach Alpha
Techno-ware	tec1	0,81	0,69	0,72
	tec2	0,76		
	tec3	0,71		
	tec5	0,56		
	tec7	0,62		
	tec8	0,54		

Table 2 shows the human-ware variable has a KMO value greater than 0.60 (Bartlett, 1950; Kaiser, 1970), which means it can be used for the research. Moreover, all its items were found to be valid because they have loading factor values greater than 0.5 [18], and the variable was also discovered to be reliable due to its Cronbach alpha value which is greater than 0.60 [22].

TABLE 2. Validity and reliability test results for human-ware

Variable	Item	Loading Factor	KMO	Cronbach Alpha
Human-ware	hum1	0,55	0,61	0,6
	hum2	0,71		
	hum3	0,71		
	hum4	0,62		
	hum5	0,73		

Table 3 shows the info-ware variable has a KMO value of 0.66 [19], [20], and this means it can be used for the research. Moreover, all its items were found to be valid because they have loading factor values greater than 0.5 [18], and the variable was also discovered to be reliable due to its Cronbach alpha value which is greater than 0.60 [22].

TABLE 3. Validity and reliability test results for info-ware

Variable	Item	Loading Factor	KMO	Cronbach Alpha
Info-ware	inf1	0,80	0,66	0,66
	inf2	0,75		
	inf3	0,78		

Table 4 shows the results for organ-ware and the KMO was found to be greater than 0.60, thereby indicating the sample is sufficient based on the assertions of [19] and [20] that a KMO value greater than 0.60 or the Bartlett value smaller than 0.05 means the research sample is sufficient and the next process of the analysis can be conducted. Moreover, the factor loading value for all its items is greater than 0.5 [18], which means they are valid. The variable was also reliable due to its Cronbach alpha value greater than 0.60 [22].

TABLE 4. Validity and reliability test results of the organ-ware

Variabel	Item	Loading Factor	KMO	Cronbach Alpha
Organ-ware	org1	0,76	0,79	0,82
	org2	0,73		
	org3	0,71		
	org4	0,56		
	org5	0,72		
	org6	0,84		
	org7	0,58		

The dependent variable, time performance, was also tested for validity and reliability. The results are presented in Table 5. It was discovered to have a sufficient number of samples because its KMO value is greater than 0.50 [19], [20]. Moreover, all items are valid as indicated by the loading factor value, which is greater than 0.50 [18], while the reliability test result presented in the last column showed it is reliable based on its Cronbach alpha value which is greater than 0.60 [22].

TABLE 5. Validity and reliability test results of the time performance

Variable	Item	Loading Factor	KMO	Cronbach Alpha
Time performance	kw1	0,64	0,57	0,60
	kw2	0,72		
	kw3	0,83		

Multiple regression analysis was used to answer the research questions. It is, therefore, important to conduct classical assumption tests including normality, multicollinearity, and heteroskedasticity before this analysis [23]. Thus, the normality was tested using a multivariate normality test with a P-P plot. The distribution of points was found to be in a straight line, as indicated in Figure 1. This means the research model is normal [24], [25].

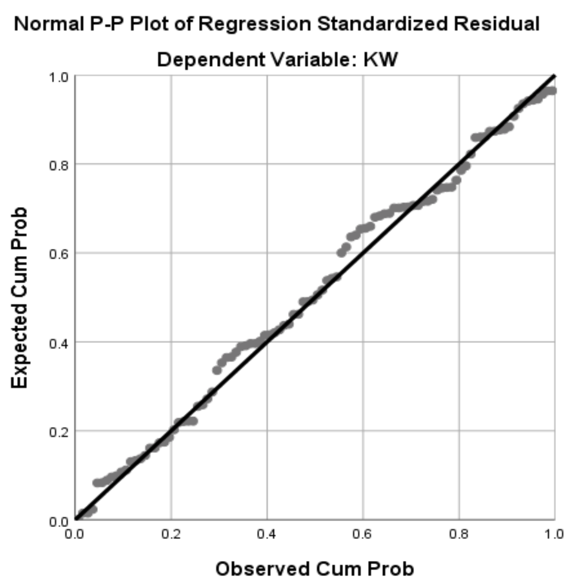

FIGURE 1. Normality Test

The second classic assumption test was multicollinearity which was conducted to ensure no relationship between the independent variables. The test is usually performed through variance inflation factor (VIF) and tolerance values [26] such that the VIF value is expected to be smaller than ten while the tolerance value should be greater than 0.10 [23]. Table 6 shows the tolerance and VIF values of all the independent variables according to these rules, which means there is no relationship between the independent variables.

TABLE 6. Multicollinearity test results

Variable	Tolerance	VIF	conclusion
TEC	0,77	1,31	no multicollinearity
HUM	0,74	1,34	no multicollinearity
INF	0,69	1,46	no multicollinearity
ORG	0,62	1,61	no multicollinearity

Another classic assumption test is heteroscedasticity conducted using the Glejser test [27], which regresses the absolute value of the residual with the independent variable. The stages involved include (i) regression of the dependent variable with independent variables, (ii) storage of residuals, (iii) transformation of residual values into absolute values, (iv) regression of absolute values of residuals with independent variables and (v) observation of significant values per variable. There is, therefore, no heteroscedasticity problem when there is no significant variable impact on the absolute residual, as indicated in Table 7, where there is no effect of the independent variable on the absolute value of the residual.

TABLE 7. Heteroskedasticity test results

Variable	B	t value	Sig value	conclusion
(Constant)	0,36	0,36	0,72	
TEC	-0,03	-0,82	0,42	
HUM	0,06	1,27	0,21	no heteroskedasticity
INF	-0,06	-1,17	0,24	
ORG	0,02	0,76	0,45	

The regression results showed the model is very fit (fit) as indicated by the F statistic value of 4.22 or the F value, which was significantly below 0.01 (α = 1%). The R-square was also recorded to be 0.15, and this means the independent variables together can explain the project time performance. In contrast, the remaining 0.85 is explained by other variables not included in this research. Moreover, the results of the regression per variable showed that only human-ware and organ-ware have an effect on project time performance at α =10%. It is important to note that there is no previous research on the impact of technological aspects on project time performance. Even though [16] used the same variables, the y variable is different, thereby making this the same first findings related to this relationship.

TABLE 8. Regression test results

variable	B	t value	Sig value	conclusion
(Constant)	7,20	4,28	0,00	-
TEC	0,00	0,03	0,97	Has no effect
HUM	0,14	1,72	0,09*	Has an effect
INF	0,06	0,71	0,48	Has no effect
ORG	0,08	1,74	0,08*	Has an effect
F statistic			4,22	
F sig			0,00	
R square			0,15	

Note. * Indicates significant at α=10%

CONCLUSION

The role of technology in project management has been identified in previous literature. Still, none has focused on the aspects introduced by the technology atlas project, centered on techno-ware, human-ware, info-ware, and organ-ware. This research showed that human-ware and organ-ware have a significant effect on project time performance. A better human-ware and organ-ware are expected to produce better project time performance. The practical implication of this research is that it shows construction industry stakeholders how to improve project time performance through the increment of human-ware. This can be achieved by assigning managers and contractor personnel based on professionalism, quality, experience, and the recruitment of sufficient and knowledgeable employees. Meanwhile, it is possible to enhance the organization by synchronizing the number of resources with needs and optimizing cooperation, communication, and coordination. These findings also contribute to the development of project management science with a focus on managing project performance. Some of the limitations of this research include the minimal number of samples, not focusing on certain stakeholders, and using multiple regression analysis methods. Therefore, further research needs to be conducted by increasing the number of respondents to get better results and focusing on certain respondents, such as contractors or owners. Other analytical methods such as Structural Equation Model (SEM) with smart-pls or AMOS approach also need to be tried by subsequent researchers.

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