

030012\_1\_5.0114900.pdf  
*by*

---

**Submission date:** 01-Jun-2023 08:20PM (UTC+0700)

**Submission ID:** 2106728384

**File name:** 030012\_1\_5.0114900.pdf (633.81K)

**Word count:** 3535

**Character count:** 19177

RESEARCH ARTICLE | JUNE 01 2023

# Project time performance: Is technology relevant?

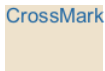
Bahrul Anif; Henike Sari; Rini Mulyani; ... <sup>6</sup> et. al

 Check for updates

*AIP Conference Proceedings* 2691, 030012 (2023)

<https://doi.org/10.1063/5.0114900>

   
View Online    Export Citation



Downloaded from [http://pubs.aip.org/aip/proc/article-pdf/doi/10.1063/5.0114900/1792398/030012\\_1-5.0114900.pdf](http://pubs.aip.org/aip/proc/article-pdf/doi/10.1063/5.0114900/1792398/030012_1-5.0114900.pdf)

## AIP Advances

Why Publish With Us?

 <b>25 DAYS</b> average time to 1st decision	 <b>740+ DOWNLOADS</b> average per article	 <b>INCLUSIVE</b> scope
--	--	---

[Learn More](#) 

# Project Time Performance: Is Technology Relevant?

Bahrul Anif<sup>1</sup>, Henike Sari<sup>1</sup>, Rini Mulyani<sup>1</sup>, Wahyudi P. Utama<sup>1</sup>, Desi Ilona<sup>2</sup>,  
Zaitul<sup>3, a)</sup>

<sup>1</sup>Faculty of Planning and Civil Engineering, Universitas Bung Hatta, Padang, 25133, Indonesia

<sup>2</sup>Faculty of Economics and Business, Universitas Putra Indonesia YPTK, Padang, 25221, Indonesia

<sup>3</sup>Faculty of Economics and Business, Universitas Bung Hatta, Padang, 25133, Indonesia

<sup>a)</sup>Corresponding author: zaitul@bunghatta.ac.id

**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 ( $\alpha=0.14$ ) and organ-ware ( $\alpha=0.08$ ). 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

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:

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

Where,

KW	: time performance
TECH	: techno-ware
HUM	: human-ware
INF	: info-ware
ORG	: organ-ware
$\alpha$	: constant
$\beta$	: regression coefficient
$\mu$	: 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

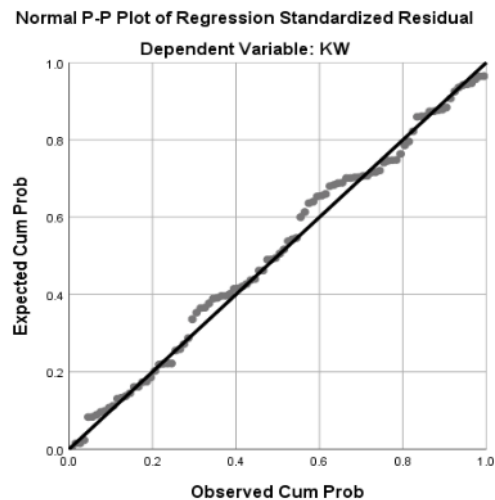
Variabel	Item	Loading Factor	KMO	Cronbach Alpha
Organ-ware	org1	0,76	0,79	0,82
	org2	0,73		
	org3	0,71		
	org4	0,56		
	org5	0,72		
	org6	0,84		
	org7	0,58		

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 **19** 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 ( $\alpha = 1\%$ ). The R-square was also recorded to be 0.15, and this **16** 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  $\alpha = 10\%$ . 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  $\alpha = 10\%$

## CONCLUSION

The role of technology in project management has been identified **8** 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.

## ACKNOWLEDGMENTS

21

We thanks to Rector of Universitas Bung Hatta for conference financial support. We also thank to the public work agency of Solok city for allowing us to collect the research data.

## REFERENCES

1. O. J. Olaniran, *J. Financ. Manag. Prop. Constr.*, 20 (3), pp. 235–251, (2015).
2. D. J. Edwards, D. G. Owusu-Manu, B. Baiden, E. Badu, and P. E. Love, *J. Eng. Des. Technol.*, 15(1), pp. 118–132, (2017).
3. C. T. Amoatey and A. N. O. Ankrah, “Exploring critical road project delay factors in Ghana,” *J. Facil. Manag.*, vol. 15, no. 2, pp. 110–127, (2017), doi: 10.1108/JFM-09-2016-0036.
4. Z. Shehu, I. R. Endut, and A. Akintoye, “Factors contributing to project time and hence cost overrun in the Malaysian construction industry,” *J. Financ. Manag. Prop. Constr.*, vol. 19, no. 1, pp. 55–75, (2014), doi: 10.1108/JFMPC-04-2013-0009.
5. H. Doloi, A. Sawhney, K. C. Iyer, and S. Rentala, “Analysing factors affecting delays in Indian construction projects,” *Int. J. Proj. Manag.*, vol. 30, no. 4, pp. 479–489, (2012), doi: 10.1016/j.ijproman.2011.10.004.
6. R. F. Aziz and A. A. Abdel-Hakam, “Exploring delay causes of road construction projects in Egypt,” *Alexandria Eng. J.*, vol. 55, no. 2, pp. 1515–1539, (2016), doi: 10.1016/j.aej.2016.03.006.
7. P. Shahsavand, A. Marefat, and M. Parchamijalal, *Causes of delays in construction industry and comparative delay analysis techniques with SCL protocol*. (2018).
8. S. Adamtey, “Cost and time performance analysis of progressive design-build projects,” *J. Eng. Des. Technol.*, vol. 19, no. 3, pp. 686–693, (2021), doi: 10.1108/JEDT-05-2020-0164.
9. D. Ilona, Z. Melmusi, H. Pratiwi, and Zaitul, “Technology context and social media adoption among small and medium enterprises,” in *Journal of Physics: Conference Series*, (2019), vol. 1339, pp. 1–7, doi: 10.1088/1742-6596/1339/1/012101.
10. A. Ezra, T. I. Nengah, S. Nursyam, I. Desi, and Zaitul, “Understanding the behavioral intention to use a university web-portal,” in *MATEC Web of Conferences*, (2018), vol. 248, pp. 1–5, doi: https://doi.org/10.1051/mateconf /201824805004.
11. Khairuddin, S. Herawati, D. Ilona, and Zaitul, “Antecedents of intention to use e-learning,” in *MATEC Web of Conferences*, (2018), vol. 248, pp. 1–5, doi: https://doi.org/10.1051/mateconf /201824805006.
12. U. Pratimaratri, D. Ilona, and Zaitul, “Digital medical data protection compliance among medical staffs,” in *Journal of Physics: Conference Series*, (2019), vol. 1339, pp. 1–7, doi: 10.1088/1742-6596/1339/1/012100.
13. D. F. Puspa, D. Ilona, and Zaitul, “Behavioural Intention to Use MYOB Accounting Application among Accounting Students,” in *Journal of Physics: Conference Series*, (2019), vol. 1339, no. 1, doi: 10.1088/1742-6596/1339/1/012126.
14. Zaitul, F. Ramadhani, and D. Ilona, “Determinants of web-user satisfaction: Using technology acceptance model,” in *MATEC Web of Conferences*, (2018), vol. 248, pp. 1–5, doi: 10.1051/mateconf/201824805009.
15. Zaitul, S. Rizki Mulyani, M. Ridwan, and D. Ilona, “Statistical software adoption behaviour among



- Indonesia's undergraduate students," in *Journal of Physics: Conference Series*, (2019), vol. 1339, pp. 1–7, doi: 10.1088/1742-6596/1339/1/012125.
16. W. Sabardi and Dewiyana, "Analisis Hubungan Komponen Technoware, Humanware, Infoware dan Organware, dengan Kepuasan Kerja Karyawan yang Dimoderator Gaya Kepemimpinan di PT. Ecogreen Oleochemicals Medan," *JURUTERA*, vol. 1, no. 1, pp. 1–8, (2014).
  17. W. Sabardi, "Analisis Hubungan Komponen Technoware, Humanware, Infoware Dan Organware, Dengan Kepuasan Kerja Karyawan yang Dimoderator Gaya Kepemimpinan pada PT. Ecogreen Oleochemicals Medan," Universitas Sumatera Utara, (2008).
  18. J. F. Hair, C. William, B. J. Babin, and R. E. Anderson, *Multivariate Data Analysis*, 7th Editio. Harlow: Pearson Education Limited, (2014).
  19. M. S. Bartlett, "Tests of Significance in Factor Analysis," *Br. J. Stat. Psychol.*, vol. 3, pp. 77–85, 1950.
  20. H. F. Kaiser, "A second generation little jiffy," *Psychometrika*, vol. 35, no. 4, pp. 401–415, (1970), [Online]. Available: <http://www.springerlink.com/index/4175806177113668.pdf>.
  21. L. J. Cronbach, "Coefficient alpha and the internal structure of tests," *Phychometrika*, vol. 16, no. 3, pp. 297–334, (1951).
  22. J. C. Nunnally, *Psychometric Theory*, 2nd ed. New York: McGraw-Hill, (1978).
  23. D. Gujarati, *Basic Econometric*. Singapore: McGraw-Hill, (1995).
  24. D. R. Anderson, D. J. Sweeney, and T. A. Williams, *Statistics for business and economics*. Minneapolis: West Publishing, (1996).
  25. A. Field, *Discovering Statistics Using SPSS*, 3rd Ed. London: SAGE Publication, (2009).
  26. U. Sekaran, *Reserch Methods For Business*. (2013).
  27. H. Glejser, "A new test for heteroskedasticity. Association 64, 316 – 323," *J. Am. Stat.*, vol. 64, pp. 316–323, (1969).

ORIGINALITY REPORT

16%

SIMILARITY INDEX

15%

INTERNET SOURCES

6%

PUBLICATIONS

7%

STUDENT PAPERS

PRIMARY SOURCES

1	<a href="http://watermark.silverchair.com">watermark.silverchair.com</a> Internet Source	4%
2	<a href="http://repo.bunghatta.ac.id">repo.bunghatta.ac.id</a> Internet Source	1%
3	<a href="http://media.neliti.com">media.neliti.com</a> Internet Source	1%
4	<a href="http://www.its.ac.id">www.its.ac.id</a> Internet Source	1%
5	<a href="http://www.matec-conferences.org">www.matec-conferences.org</a> Internet Source	1%
6	Submitted to Universiti Teknologi Petronas Student Paper	1%
7	<a href="http://s3.amazonaws.com">s3.amazonaws.com</a> Internet Source	1%
8	<a href="http://koreascience.kr">koreascience.kr</a> Internet Source	1%
9	Wahyu Kurniawan, Su'ad, Sukirman. "Determinant factors of extraordinary	1%

elementary school teacher professionalism",  
Journal of Physics: Conference Series, 2021

Publication

---

10	<a href="http://journal.unika.ac.id">journal.unika.ac.id</a> Internet Source	1 %
11	<a href="http://journal.ugm.ac.id">journal.ugm.ac.id</a> Internet Source	<1 %
12	<a href="http://pdfs.semanticscholar.org">pdfs.semanticscholar.org</a> Internet Source	<1 %
13	Submitted to University of Malaya Student Paper	<1 %
14	<a href="http://cib.natixis.com">cib.natixis.com</a> Internet Source	<1 %
15	<a href="http://journal.unnes.ac.id">journal.unnes.ac.id</a> Internet Source	<1 %
16	Zaitul Zaitul, Zerni Melmusi, Desi Ilona. "Corporate Governance and Bank Performance: Global Financial Crisis 2008", Journal of Reviews on Global Economics, 2019 Publication	<1 %
17	<a href="http://bunghatta.ac.id">bunghatta.ac.id</a> Internet Source	<1 %
18	Khairul ., Eugene Okyere-Kwakye, Desi Ilona, Zaitul .. "Students' Intention to Participate in E-learning", KnE Social Sciences, 2020 Publication	<1 %

---

19

ds.amu.edu.et

Internet Source

<1 %

20

escholarship.org

Internet Source

<1 %

21

knepublishing.com

Internet Source

<1 %

22

Zaitul Zaitul, Desi Ilona. "Is Financial Literacy Associated With SME Sustainability During COVID-19?", KnE Social Sciences, 2022

Publication

<1 %

Exclude quotes Off

Exclude matches Off

Exclude bibliography On