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Analysis of Labor Productivity Level and Time Performance Satisfaction in the SMAN 10 Denpasar Development Project

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Abstract

The project is a series of work that aims to achieve project objectives according to the requirements that have been set at the beginning of the project such as quality, time, and cost requirements. In the current era of globalization, every worker in all sectors including the construction sector is required to have high worker productivity. Productivity is very important for every worker in completing a job, the lack of awareness of the workforce on the importance of productivity is one of the causes of the low work produced. This study aims to determine the level of productivity and satisfaction with time performance. The data used in this study were analyzed by measuring productivity and satisfaction of watuk performance measured by the SPI value. The level of labor productivity in architectural work, Heabel work = 7%, plastering and finishing work = 13%, painting work = 9%, door and window frame installation work (Bengkirai wood) = 29%, scouring brick installation work = 54% , Bali paras stone installation work = 4%, lava rock installation work = 9%, railing installation work = 51%, ceramic installation work = 11% and schedule performance index (SPI) for structural work for SMAN 10 Denpasar project in the 1st week until the 15th week showed an SPI value >1.

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1 Introduction

According to Purnomo (1999), the project is a series of work that aims to achieve project objectives according to the requirements set at the beginning of the project such as quality, time and cost requirements. Meanwhile, according to Dipohusodo (1996), a construction project is a project related to efforts to build an infrastructure building, which generally includes main work which includes civil engineering and architecture. According to Soemardi et al. (2006), that in the process of achieving the goals of a project, there are limitations that must be met, namely the amount of cost (budget) allocated, schedule and quality that must be met.

In the current era of globalization, every workforce in all sectors including the construction sector is required to have high work productivity so that they can continue to exist and compete in their fields. Productivity is very important for every worker in completing a job, the lack of workforce awareness of the importance of productivity is one of the causes of the low work produced. (Meliasari & Indrayadi, 2011), (Muchdarsyah, 2003), gives an example in a work unit there are about 75% of the workforce who do not make good use of working time, namely by doing activities that should not be done. The low productivity of the workforce in Indonesia demands an increase in productivity. However, the many factors that affect productivity make it difficult to increase productivity.

Performance is an important thing in the sustainability of the project. Performance can be measured if the individual can carry out his duties well. However, in project implementation, sometimes service providers pay less attention to these aspects because service providers want to get more profit and keep operational costs to a minimum. With quality resources, it is hoped that all project management performance activities can be carried out as planned. Project performance is the work achievement achieved in doing the work which is reflected in the final results produced in accordance with the desired quantity and quality.

Research by (Syahroni, 2019), explains, The factors that influence project stakeholder satisfaction include quality, time, cost, and managerial. In the research of Maulana and Febri, good construction project performance will have good construction project quality as well. The parties (stakeholders) involved directly and indirectly in construction projects are required to have competitive services through creative, innovative, and efficient efforts so that all correctly understand the needs and expectations of project quality at present and in the future (Farr, 1976; Shikdar & Das, 2003; Shehata & El-Gohary, 2011).

Problems in the project will always arise, both predictable and unpredictable. If this problem is not managed properly, it will become a conflict or dispute between the elements involved in the implementation of the project. Conflict is a condition of incompatibility with the goals to be achieved in the organization. The conditions that have been stated can affect work efficiency and productivity. Building construction generally has complex problems. The complexity of problems in the construction of commercial building projects usually occurs at the project implementation stage. This requires the contractor who is directly involved in the project to ensure the level of satisfaction offered in the construction project being undertaken. This study aims to analyze the effect of project performance on the level of project stakeholder satisfaction, as well as to determine the project performance factors to influence the level of stakeholder satisfaction (Van Birgelen et al., 2006; Graen et al., 1982; Pemayun & Martini, 2021).

2 Materials and Methods

The data used in this study are primary data and secondary data. Primary data is taken by means of observations and surveys in the project work process. Productivity data collection through direct field observation, namely data in the form of observed time, observed rating, standard rating recorded in the observation form using the time study method and for performance satisfaction, the primary data obtained by the authors in this study is the daily project report. The following are the stages of the research:

1) Identification of the problem at this stage, the formulation of the problem from the background that has been stated is then determined by the research topic to be discussed.
2) Study of related literature Based on the existing problems, reviewed the data related to the topics discussed, namely the risk variables on material resources that affect the cost performance of high-rise building projects.
3) Collecting project data by obtaining data in the form of working drawings, time schedules, daily reports, RKS and RAB.

4) Time calculation in the field uses cumulative calculations or continuous time measurements where the clock starts from the start of the work and the hours are not stopped until all work is finished at 17.00 WITA. Hour readings at the end of each job are recorded and the time obtained by subtraction after that. Ineffective times encountered in observations should be calculated and recorded appropriately. This ineffective time includes rest and relaxation, correcting mistakes, doing unrelated work, idle time and waiting for materials, and waiting for other work, so this ineffective time can be taken as a continuous calculation (Kim et al., 2020; Espinosa-Garza et al., 2017; Yi et al., 2011).
5) Collecting productivity data through direct field observations, namely data in the form of observed time, observed rating, and standard rating recorded in the observation form using the time study method. After that, the data obtained will be processed into standard time, and also record the volume worked per day which will then be used to calculate productivity.
6) Analyzing project time control, and schedule performance index using the SPI value to determine work performance that is able to achieve the planned work target or not.
7) Results and Discussion the results are obtained in the form of the level of work productivity and performance satisfaction.
8) Drawing conclusions from the results and subsequent discussion will validate the findings with adjustments to the literature.

3 Results and Discussions

In this study, there are 5 variables that affect the productivity of workers on architectural work projects in the post-graduate building of Bali Polytechnic and Tourism. These factors are shown in the table below, the following is a table of the results of the identification and reference of risk variables used in this study.

Table 1
Material management risk variables used

No	Influential Variables	Source
1	working age	Literature study and interview results
2	Field Condition	Literature study and interview results
3	Skills and Work Experience	Literature study and interview results
4	Wage Match	Literature study and interview results
5	Worker Health	Literature study and interview results

According to Muchdarsyah (2003), productivity is an effective economic resource that requires organizational and technical skills so that it has a high level of use. In the world of construction, labor productivity is the level of labor's ability to produce products or complete a job with a certain volume within a certain time limit under standard conditions and is measured in units of volume/hour. Therefore, in an effort to analyze labor productivity, variables that might affect the level of productivity must be considered.

Table 2
The level of productivity

Heabel's Job										
No	Number of Workers (person)	Processing time	Earned Volume (days)	Working Hours (hours)	Productivity Volume/Hour	Unit	Total Work Volume	Length of work	Week-	Planned Schedule (days)
	Foreman	From Hours	56.3	8					7th week	
1	1 Craftsman 7	08.00 to with clock 17.00			7,0375	m2	1105,01	20		21

	Server 5									
Plastering and Finishing Work										
	Foreman 1	From Hours 08.00 to		8					Sunday	
2	Craftsman 6	with clock 17.00	243,9		30,4875	m2	1951,64	8		9
	Server 5									
Painting Job										
	Foreman 1	From Hours 08.00 to		8					Weeks 10,11,16,	
3	Craftsman 8	with clock 17.00	354,45		44,30625	m2	10043,45	28		31
	Server 4									
Door and Window Frame Installation Work (Bengkirai wood)										
	Foreman 1	From Hours 08.00 to		8					Sunday	
4	Craftsman 6	with clock 17.00	6,5		0,8125	m3	15,21	2		3
	Server 4									
Bricks Laying Work										
	Foreman 1	From Hours 08.00 to		8					Sunday	
5	Craftsman 8	with clock 17.00	22,8		2,85	m2	631,67	28		43
	Server 6									
Bali Paras Stone Installation Work										
	Foreman 1	From Hours 08.00 to		8					Week	
6	Craftsman 8	with clock 17.00	76,3		9,5375	m2	2679,86	35		37
	Server 5									
Lava Rock Installation Work										
	Foreman 1	From Hours 08.00 to		8					Sunday	
7	Craftsman 8	with clock 17.00	32,2		4,025	m2	1411,63	44		48
	Server 5									
Relling Installation Work										
	Foreman 1	From Hours 08.00 to		8					Sunday	
8	Craftsman 6	with clock 17.00	15,5		1,9375	m1	71,8	5		7
	Server 4									
Ceramic Installation Work										
9	Foreman	From	49,5	8	6,1875	m2	1782,42	36	Weeks	40

	Hours	10,11,13,
1 Craftsman 7 Server 5	08.00 to with clock 17.00 From Hours 08.00 to	

In the table above, the results of the calculation of productivity for each architectural work in the SMAN 10 Denpasar project are obtained, and then the data is used to calculate the level of work productivity.

Table 3
Work productivity

Work Productivity Comparison Table				
No	Job Name	Plans in the Field	Early Realization (Days)	Difference (Days)
1	Heabel's Job	(day)	6,58	0,45
2	Plastering and Finishing Work	7.03	27,11	3,30
3	Painting Job	30.48	40,50	3,80
4	Door and Window Frame Installation Work (Bengkirai wood)	44.30	0,63	0,18
5	Bricks Laying Work	0.81	1,84	1,01
6	Bali Paras Stone Installation Work	2.85	9,05	0,36
7	Lava Rock Installation Work	9.53	3,68	0,34
8	Railing Installation Work	4.02	1,28	0,65
9	Installation work	1.93	5,57	0,61

From the table of the level of labor productivity on architectural work that is reviewed in the field, the results are like the table above with the formula

Productivity Level = (Difference in Productivity / Planned Productivity) x 100%

Table 4
Productivity rate

No	Work	Productivity Rate (%)
1	Heabel's Job	7%
2	Plastering and Finishing Work	13%
3	Painting Job	9%
4	Door and Window Frame Installation Work (Bengkirai wood)	29%
5	Bricks Laying Work	54%
6	Bali Paras Stone Installation Work	4%
7	Lava Rock Installation Work	9%
8	Railing Installation Work	51%
9	Installation work	11%

Time performance analysis

The basic concept of result value can be used to analyze performance and make forecasts of target achievement, (Atmaja et al., 2020). For this purpose, two indicators are used: BCWS (Budgeted Cost of Work Scheduled) and BCWP (Budgeted Cost Of Work Performance) Analysis (Soemardi et al., 2006). This indicator is the same as the budget for a work package but is structured and linked to an implementation schedule. So here there is a combination of cost, schedule and scope of work, where each element of the work has been allocated a cost and schedule that can be used as a benchmark in the implementation of the work.

BCWS analysis (Budgeted cost of work schedule)

Analysis of the amount of budget allocated based on the work plan that has been prepared against time (BCWS). The weekly BCWS value can be obtained based on the weekly weight in the Budget Time Schedule (Syahroni, 2019), calculated as follows:

Table 5
BCWS analysis (Budgeted cost of work schedule)

Week	BAC	% Planned cumulative weight	BCWS	
1		0	-	
2		0,31	Rp	11.003.309,06
3		0,62	Rp	22.016.618,11
4		1,17	Rp	41.556.359,99
5		3,4	Rp	120.781.131,59
6	3.552.680.341	7,04	Rp	250.098.696,01
7		20,06	Rp	712.657.676,40
8		37,93	Rp	1.347.521.653,34
9		51,6	Rp	1.833.173.055,96
10		62,87	Rp	2.233.560.130,39
11		73,6	Rp	2.614.762.730,98
12		87,31	Rp	3.101.835.205,73
13		95,97	Rp	3.409.497.323,26
14		99,3	Rp	3.527.801.578,61
15		100	Rp	3.552.670.341,00

BCWP Analysis (Budgeted cost of work performance)

Analysis of the number of costs incurred in accordance with the work that has been completed (BCWP). The weekly BCWP value can be obtained based on the schedule data for the implementation of the work progress or the weekly project report, calculated as follows:

Table 6
BCWP Analysis (Budgeted cost of work performance)

Week	BAC	% Actual cumulative weight	BCWP	
1		0,46	Rp	16.332.329,57
2		4,34	Rp	154.176.326,80
3		13,96	Rp	495.944.175,60
4		24,1	Rp	856.185.962,18
5	3.552.680.341	34,07	Rp	1.210.388.192,18
6		45,06	Rp	1.600.827.761,65
7		56,28	Rp	1.999.438.495,91

8	60,04	Rp	2.133.019.276,74
9	68,33	Rp	2.427.536.477,01
10	79,82	Rp	2.835.739.448,19
11	84,38	Rp	2.997.741.671,74
12	91,83	Rp	3.262.416.357,14
13	97,77	Rp	3.473.445.569,40
14	99,81	Rp	3.545.920.248,35
15	100	Rp	3.552.670.341,00

Table 7
Analysis of deviations against time (SV)

Schedule Varian SV Analysis							
Week-	BCWP		BCWS		SV		SV (%)
1	Rp	16.332.329,57	Rp	-	Rp	16.332.329,57	0,46
2	Rp	154.176.326,80	Rp	11.003.309,06	Rp	143.173.017,74	4,03
3	Rp	495.944.175,60	Rp	22.016.618,11	Rp	473.927.557,49	13,34
4	Rp	856.185.962,18	Rp	41.556.359,99	Rp	814.629.602,19	22,93
5	Rp	1.210.388.192,18	Rp	120.781.131,59	Rp	1.089.607.060,58	30,67
6	Rp	1.600.827.761,65	Rp	250.098.696,01	Rp	1.350.729.065,65	38,02
7	Rp	1.999.438.495,91	Rp	712.657.676,40	Rp	1.286.780.819,51	36,22
8	Rp	2.133.019.276,74	Rp	1.347.521.653,34	Rp	785.497.623,40	22,11
9	Rp	2.427.536.477,01	Rp	1.833.173.055,96	Rp	594.363.421,05	16,73
10	Rp	2.835.739.448,19	Rp	2.233.560.130,39	Rp	602.179.317,80	16,95
11	Rp	2.997.741.671,74	Rp	2.614.762.730,98	Rp	382.978.940,76	10,78
12	Rp	3.262.416.357,14	Rp	3.101.835.205,73	Rp	160.581.151,41	4,52
13	Rp	3.473.445.569,40	Rp	3.409.497.323,26	Rp	63.948.246,14	1,80
14	Rp	3.545.920.248,35	Rp	3.527.801.578,61	Rp	18.118.669,74	0,51
15	Rp	3.552.670.341,00	Rp	3.552.670.341,00	Rp	-	0,00

From the calculation results above, it can be seen that the 1st to 11th week of SV value is very high, this result indicates that the implementation of the work is faster than the planned schedule and the work productivity is very high (Lim & Alum, 1995; Panach et al., 2015; Mulawarman, 2022; Laksono, 2007). In the 11th to the 15th week, the SV value also increased, but not as significant as the previous week, the SPI value in the 1st to 15th week of the SPI value was > 1, meaning that the project implementation was faster than planning. For the calculation of the SPI the week before and after, in the same way as above, see the table

Table 8
Schedule performance index SPI analysis

Schedule Performance Index SPI Analysis					
Week	BCWP		BCWS		SPI (%)
1	Rp	16.332.329,57	Rp	-	16,79
2	Rp	154.176.326,80	Rp	11.003.309,06	14,01
3	Rp	495.944.175,60	Rp	22.016.618,11	22,53
4	Rp	856.185.962,18	Rp	41.556.359,99	20,60
5	Rp	1.210.388.192,18	Rp	120.781.131,59	10,02
6	Rp	1.600.827.761,65	Rp	250.098.696,01	6,40
7	Rp	1.999.438.495,91	Rp	712.657.676,40	2,81
8	Rp	2.133.019.276,74	Rp	1.347.521.653,34	1,58
9	Rp	2.427.536.477,01	Rp	1.833.173.055,96	1,32
10	Rp	2.835.739.448,19	Rp	2.233.560.130,39	1,27
11	Rp	2.997.741.671,74	Rp	2.614.762.730,98	1,15

12	Rp	3.262.416.357,14	Rp	3.101.835.205,73	1,05
13	Rp	3.473.445.569,40	Rp	3.409.497.323,26	1,02
14	Rp	3.545.920.248,35	Rp	3.527.801.578,61	1,01
15	Rp	3.552.670.341,00	Rp	3.552.670.341,00	1,00

The BCWP is the total cost incurred on the weight of the work that has been carried out. BCWS is the sum of the planned costs on the planned work weights.

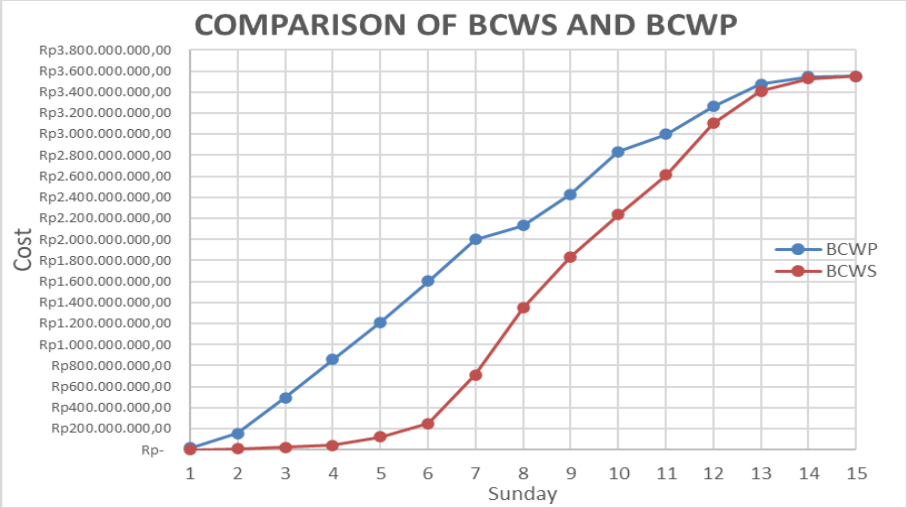

Figure 1. Comparison of BCWS And BCWP

From the comparison picture, the BCWS and BCWP values show that the BCWS value is below the BCWP value in the 1st week to the 15th week. This shows that the weight of the realization of the work is in line with even progressing with what has been scheduled or planned. In controlling time, the results of the calculation of variance show the project conditions that occur every week. A negative variance indicates that there is a delay in the project against the plan (schedule underrun). Zero indicates the work is carried out according to schedule. While a positive number means that the project is accelerating against the plan. The SV value can be seen in the following figure.

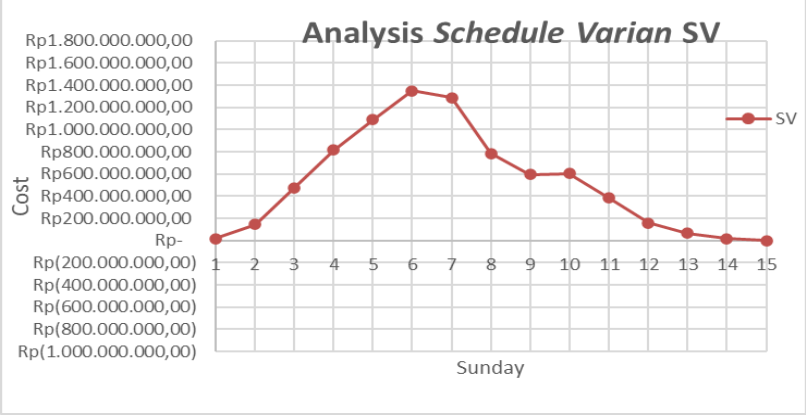

Figure 2. Analysis schedule varian SV

The picture above shows that the schedule variance value at week 1 to week 15 is positive, it means that the project performance is in accordance with the plan. In project time control, the schedule performance index which shows that the SPI value is less than one means that the work performance is not as expected because it cannot meet the planned targets (Abma, 2016). When the performance index figures are reviewed further, the following will be seen (Meliasari & Indrayadi, 2011).

a) The performance index number is less than one, meaning that the work performance is not as expected because it is unable to achieve the planned work target.
b) The performance index number is more than one, meaning that the work performance is better than planned.
c) The greater the difference from number 1, the greater the deviation from the basic planning or budget. Even if the number is too high, which means that the performance of the work is very good, it is necessary to study whether it is possible that the planning is actually unrealistic.

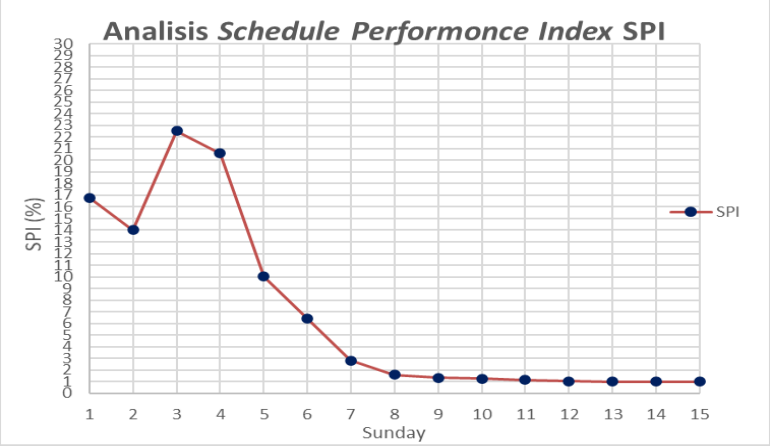

Figure 3. Analysis schedule performance index SPI

Comparison of SPI values can be seen that the SPI value in the 1st week to the 15th week shows a value greater than 1, which means the work performance is better than planned / the project is progressing. This is because the contractor accelerated by adding overtime hours of work. However, due to the overtime hours, the contractor will also have to bear the project's profits which will decrease. To measure the level of satisfaction with the performance of the implementation time, the author uses the method of measurement scale with the following indicators:

SPI < 1 = Dissatisfied (TP)
SPI = 0 = Quite Satisfied (CP)
SPI > 1 = Satisfied (P)

Table 9
Satisfaction with the performance

Week-	SPI (%)	Indicator
1	16,79	(P)
2	14,01	(P)
3	22,53	(P)
4	20,60	(P)
5	10,02	(P)
6	6,40	(P)
7	2,81	(P)
8	1,58	(P)
9	1,32	(P)
10	1,27	(P)
11	1,15	(P)
12	1,05	(P)
13	1,02	(P)
14	1,01	(P)
15	1,00	(P)

So based on the analyzed data, it can be concluded that the time performance of the SMAN 10 Denpasar project structure work has reached satisfaction because the SPI every week is greater than one.

4 Conclusion

Based on the results and discussions described in the previous chapter, the following conclusions can be drawn:

1) The level of labor productivity in architectural work, Heabel Works = 7%, Plastering and Finishing Works = 13%, Painting Works = 9%, Door and Window Frame Installation Work (Bengkirai wood) = 29%, Brick Installation Work = 54%, Bali Paras Stone Installation Work = 4%, Lava Rock Stone Installation Work = 9%, Railing Installation Work = 51%, Ceramic Installation Work = 11%.
2) The schedule performance index (SPI) of the SMAN 10 Denpasar project structure in the 1st week to the 15th week shows an SPI value > 1, where the project implementation is faster than the planning

Conflict of interest statement
The authors declared that they have no competing interests.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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