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Student Course Satisfaction in Learning Management System

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Abstract
The paper entitled " Student Course Satisfaction in Learning Management System" is based on one-cycle technical action research methodology. It aimed to enhance students learning participation in LMS. The participants for this study were 26 students studying Mathematics and English education at ODEC, TU. Tools used in the study were baseline, and end-line survey on (a) students course satisfaction on LMS and (b) students perception on usefulness of four pedagogical tools in LMS: content tools, communication tools, feedback tools, and assessment tools. The reliability and validity of the tools were established by Cronbach alpha and principal component factor analysis. The data in the study were collected through an online Google form before and after AR intervention. The collected data were analyzed using inferential statistics t-test for significance test. Based on the result, this study found that students were more satisfied from LMS when it is re-designed according to AR intervention for engaged and interactive pedagogical tools: content tools, communication, and interaction tools, feedback and support tools. However, assessment tools were found to re-design in the next cycle. The study also found that math students were more satisfied from LMS than English students. Boys students were more satisfied in LMS than Girl students. However, the reasons need to the explorer in the next cycle. From the study, it is concluded that LMS itself is not a sufficient tool to enhance students learning participation, but it needs to design with pedagogical thoughtfulness while implementing an online learning environment. So, creating an engaged and interactive learning environment helps to increase student's course satisfaction in LMS. As a teacher cum researcher, it is learned that LMS should design to maintain a reciprocal relationship between teacher, student, and learning content.

Key Words: Student Course, Learning Management System

Introduction

Due to the internet and technology-based educational practices during last two decades, new jargons like hybrid learning, e-learning, o-learning, M-learning, U-learning, MOOC, SOOC, etc. have been emerging to represent technology integrated educational practices. As a result, educational institutes are under increasing pressure to respond and adapt this rapidly growing online/hybrid educational practices. Central Department of Education (CDED), TU is also adopting this online/hybrid educational practices since last four years under ODEC and Quantict Collaboration.

With the implementation of the online/hybrid educational environment in CDED, faculties at CDED are aware that it is really necessary to create engaged and interactive learning environments in LMS. However, a significant gap is seen between what is expected and what is implemented. For example, this gap is seen in CDED to design engaged, and interactive LMS, it CDED case, the LMS is Moodle. For example, one evidence of gap is, there was a number of courses (34 courses; 4 from Education, 14 from Mathematics, and 14 from

English) proposed to design in online delivery mode. Quantict had already started this initiative requiting CDED faculties since 2015 to design the courses for the online environment. However, a few numbers of courses are built for Moodle friendly environment. The designed courses still demand sufficient work to be done both in content and pedagogy for Moodle friendly environment.

From this gap, a question is raised. How be the online courses at CDED designed to support students learning expectations? This concern of maximizing student's learning exception and its online course satisfaction has grounded this research study. This study, in this essence, is concentrated to investigate and enhance student's course satisfaction in LMS at CDED context.

Research Questions

The focus of the study was to investigate the following research questions.

1. What is the relationship between student perception of LMS course content tools usefulness and student LMS course satisfaction?
2. What is the relationship between student perception of LMS course assessment tools usefulness and student LMS course satisfaction?
3. What is the relationship between student perception of LMS course communication/collaboration tools usefulness and student LMS course satisfaction?
4. What is the relationship between student perception of LMS course feedback tools usefulness and student LMS course satisfaction?
5. What is the relationship between boys' and girls' perception of LMS course satisfaction?

In relation to the above research questions, action intervention on "Online Course Management: Principles and Design" was injected for course tutors to update LMS features in Moodle platform. Then Moodle LMS update was carried out by course tutors themselves. For this update, required knowledge for teachers to work in Moodle was disseminated in a joint workshop in collaboration with Quantict and ODEC. Before and after this intervention, baseline and end-line course satisfaction survey were administered. Based on the survey result, research questions were analyzed.

Review for Conceptual Framework

Technology and its innovative use into the classroom have been a long-standing tradition in education. Some technologies like radio and television come and go, tried and tossed in the classroom. In the 1980s, computer technology entered into the classroom as another innovative educational and instructional technology. Since the 1990s, LMS has been introduced to enhance students learning.

LMS use is new and just a kick-off (beginning) practices in Nepal. Therefore, it requires an understanding on how to use LMS effectively, in the context of Nepal. In the literature, it is mentioned that, if LMS is used properly, there can be a number of benefits for students learning both in cognitive and meta-cognitive aspects. It is justified in a work that the impact of technology integration largely depends on how it is implemented (Conole & Dyke, 2004) & further, justified by a work that technology's benefit on student learning depends on how the technology is implemented (Li & Ma, 2010). However, it is still hard to know how technology can be best thoughtfully used for instructional purposes. How its use can be localized in the context of Nepal. Therefore, it also equally important to know how LMS improves students' learning.

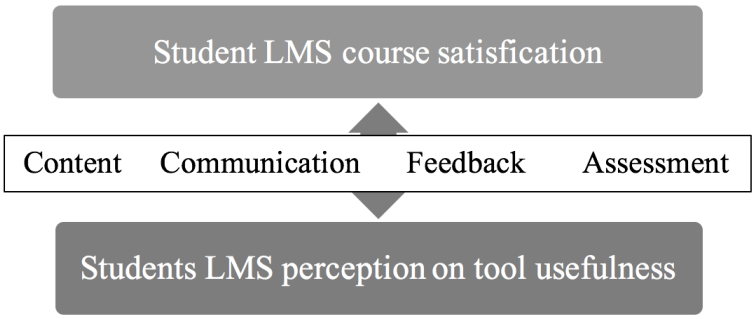
Research finding suggests that Educators who use educational technology effectively, can strengthen quality instruction and leads to increased student learning (Raines & Clark, 2011). In work, it is recommended that the instructor must use technology to facilitate student learning by using effective learning management principles (Baghdadi, 2011). It is, therefore, important to design LMS to guide student learning effectively.

Today, a number of educational technology tools are part of LMS as pedagogical tools (Yueh & Hsu, 2008). The number of such pedagogical tools that can be used in LMS are peer work, forums, lessons, quiz, assignments,

chat, and wikis. These tools can help to peruse well-designed engaged and interactive learning environments. Simply adding these tools in LMS may not work effectively, rather it may work effectively if these tools are designed thoughtfully. Online learners highly value a course when the course content is "well-organized, effectively presented, interactive, clearly written, flexible, right length and breadth" (Ozkan & Koseler, 2009). In this essence, designing LMS to address students need can be a common measure of instructional effectiveness.

While measuring the instructional effectiveness, there is a number of theories to answer how students learn. These theories are the framework to manage students learning. There are different orientations and approaches to explain this phenomenon. For example, behaviorism, cognitivism, and constructivism. The connectivism is also a growing phenomenon, even if there is a discourse to accept it as a learning theory. Among the four, constructivism is a learning theory that assumes learning as a function of activities (action). This theory is conceptualized by Piaget (Piaget, 1954) for individual level and Vygotsky (1978) at the social level. This theory argues that learning is active and generated from the interaction between and within people's actions, experiences, and subjective states of mind. The theory asserts that learning is internal and constructed, so the action is a prime source of learning.

By constructive learning theory, learning is a function if participatory, cooperative, and collaborative actions. Based on this theory, this paper understands the notion of learning as "higher the engagement higher the learning" which is here and there argued in a number of works (Vygotsky, 1986; Vygotsky, 1978; Siemens, 2005; Downes, 2005). Therefore, these students reflects student learning through their perceptions on pedagogical activities. The pedagogical activities reflected in this study are course contents, communication, and interaction within and between students and teachers, feedback and support to excel student learning, and assessment of/for/in the learning. In this essence, student's course satisfaction and its effectiveness have measured from the relationship between student LMS course satisfaction versus student's perceptions of LMS pedagogical activities (tools) usefulness. In general, the framework is conceptualized as below.



In the framework, students LMS course satisfaction is function of four pedagogical activities, i.e., students LMS course satisfaction is a real-valued multivariate function *f*(Content, Communication, Feedback, Assessment). The score of the function *f* is accumulated from students' score on Content, Communication, Feedback, and Assessment usefulness. Then, the interaction between students LMS course satisfaction and their perception of pedagogical tool usefulness (Content, Communication, Feedback, and Assessment) are analyzed.

Methodology

This study is based on one cycle action research (AR) methodology to observe, reflect, re-observe, and confirm the reality among the community of learner. AR is used because of the researched need opportunity for reflection, improvement, and transformation on educational practice. McNiff & Whitehead (2006) mentioned that social situations are created by people, so it can be reconstructed for better practice. In this essence, AR is used to enhance students learning opportunity on LMS.

In general, there are three forms of AR (McNiff & Whitehead, 2006). The researcher has deployed an empirical/ technical form of T-AR because it tries to maintain the objectivity of the research field to see cause and effect relationship, like ‘if x, then y,' where results are generated by statistical analysis and can be applied and

generalized, and replicable in similar conditions. The researcher has avoided the interpretive AR, which tries to observe events in natural settings to describe and explain on "what is being/doing there" and to understand about "what is happening" and negotiate meanings about objectivity. Beyond both AR, the researcher has avoided participatory AR, because it envisages a collaborative approach of investigation to engage "subjects: researcher" and "objects: participants" with interest in common problems. Therefore, T-AR is used to improve educational practices incorporating the core elements plan, act, observe/ reflect, modify, and move in feasible directions based on if "x" then "y" relationships.

In this study, T-AR was utilized in the context of students course satisfaction in LMS at CDED context. First of all, students baseline on course satisfaction in LMS was collected.

Then an action intervention was taken with working faculties to update and to make LMS more engaged and interactive. Then course updated on Moodle was carried out. This single cycle action research (plan, act, observe, and reflect) was carried out by the following activities. (a) Baseline information on students course satisfaction in LMS was collected. Based on collected information and reflection over it, (b) action goals were determined (plan). The action intervention was to update LMS as with pedagogical tools as developed in the conceptual framework (Plan/Act). Based on the plan, (c) an intervention workshop and hands-on support were carried out to update LMS (Acting). Finally, after two months interval of re-designed LMS implementation, (d) end-eline information on students course satisfaction in LMS was collected through the survey (Observing). Based on the baseline and end-line survey responses, (e) effectiveness on action intervention was analyzed (Reflecting). The details of the methodology adopted in this study are as follows.

Participants of the Study

The participants in this study were master's students of mathematics and English education at ODEC, University Campus, Kirtipur. These participants were first semester students during the academic year 2018. The study used ODEC students because they were online students and studying their courses through Moodle LMS. The total enrolled students in ODEC were 36, of which 26 (70%) participated in both baseline and end-line survey. Therefore, 26 students were considered as study participants. Among 26 students, 13 were boys (73%), and the remaining 7 were girls (27%). Among 26 students, 13 were from mathematics education (50%), and the remaining 15 were from English education (50%).

The independent and dependent variable

The dependent variable in the study was a student's LMS course satisfaction. This variable was computed from survey responses on four pedagogical constructs: content tools; communication and interaction tools; feedback and support tools; and assessment tools. The independent variables in the study were the usefulness of content tools, assessment tools, communication/collaboration tools, and feedback tools. All these independent variable were measure from survey opinionnaire based on a five-point Likert scale.

Action Intervention

In this study, AR action intervention was a workshop on "Online course management: Principles and Design." This three-day-long intervention was carried out to working faculties who were tutoring courses under ODEC. The faculties were tutoring ODEC students through Moodle LMS. Therefore, faculty support workshop was carried out to make Moodle LMS more engaged and more interactive. This workshop was based on discussion cum hands-on support. Basically, the action workshop was based on LMS update features on four pedagogical tools. These pedagogical tools were Contents tools, Communication/collaboration tools, Feedback and support tools, and Assessment tools.

The content tools discussed in the workshop were Reading Materials, Lecture Slides, E-book, Audio video resources, Teacher's Recorded Video, Discussion Forum, Glossary, Lesson, and Wiki. The communication/collaboration tools discussed in the workshop were Chat-room, Discussion board, Email, Sms,

use of Facebook as Social media, Blog, and live Virtual classroom. The feedback and support tools discussed in the workshop were News and Forum for Announcements, Moodle Page with Course Information, Calendar with Due Dates, Choice (Poll), Question Board, Use of email, sms for notification, telephone and message for instant need, and Use of feedback files. The assessment tools discussed in the workshop were Quiz, Assignment, Games, Peer review assignment, Project work / Case study. Finally, based on the workshop and hand on support, the courses were upgraded in Moodle LMS with four level pedagogical constructs by the course teacher themselves. The course tutors were supported wherever and whenever they need help to design the activities in Moodle LMS.

Data collection and analysis procedure

In this study, the data were collected from survey opinnioire. The opinnioire was based on the usefulness of four pedagogical constructs: content tools, communication and interaction tools, feedback and support tools, and assessment tools. In these tools usefulness, the survey opinnioire, there were five options to respond: 5 -very useful, 4 - somewhat useful, 3-don't know, 2 - not useful, 1 - N/A- didn't use. In student LMS course satisfaction, there were four constructs. The survey opinnioire for these constructs were leveled in four options: 4=very satisfied, 3= somewhat satisfied, 2=not satisfied, 1=it is bad.

The reliability and validity of survey were established by statistical analysis. Reliability is concerned with the precision and accuracy of tools. It is essentially a synonym for consistency and possibility to replicate in a similar situation over time, instruments, and groups of respondents (Creswell, 2014). In this study, the reliability of survey items was calculated with Cronbach alpha coefficient in SPSS 18, and it was 0.81. This Cronbach alpha coefficient indicated 64% reliability factor, therefore, the survey tool is accepted to use in this study. For research to be valid, it must demonstrate content coherent (Denzin & Lincoln, 2005). In this study, the validity of the tools was established by principle component factor analysis.

In this study, the data were collected through an online Google form. This Google form link was attached to the LMS course home page. In addition, Google form was sent to students through students email. After, two months interval of AR action intervention, the Google form was re-sent to those students. Google form link as URL was re-activated to LMS course home page. There were, 36 students enrolled in the ODEC courses, however, 26 students replied in both baseline and end-line survey. Therefore, these 26 responses were considered for further analysis. These 26 responses were analyzed using inferential statistics t-test for significance test at 5% level into four pedagogical constructs.

The student LMS course satisfaction was collected from learning resources, communication and interaction, activities and assignments, feedback and support, and assessment and evaluation. Similarly, student perception on pedagogical tool usefulness was measured from content tools usefulness, assessment tools usefulness, communication/collaboration tools usefulness and feedback tools usefulness.

The student perception of LMS course content tools usefulness was collected from Reading Materials, Lecture Slides, E-book, Audio video resources, Teacher's Recorded Video, Discussion Forum, Glossary, Lesson, and Wiki.

The student perception of LMS course communication/collaboration tools usefulness was collected from Chatroom, Discussion board, Email, Sms, Social media, Blog, Virtual Classroom.
The student perception of LMS course feedback and support tools usefulness was collected from News and Forum for Announcements, Moodle Page with Course Information, Calendar with Due Dates, Choice, Question Board, Use of email, SMS, telephone and message, Use of feedback files.

The student perception of LMS course assessment tools usefulness was collected from Quiz, Assignment, Games, Peer review assignment, Project work / Case study.

Ethical Considerations

The ethical issue in the study was ensured. The participants in the study were informed that their participation is voluntary and that they could at any time decide to discontinue their participation or decline to answer any question or stop the participation for any reason without penalty. In addition, they were informed that confidentially and anonymity will be maintained for their responses.

Result of the study

The study was carried out to analyze students LMS course satisfaction through faculty support workshop. For this, action intervention was implemented. The effect action intervention was analyzed with reference to five research questions. These research questions were related to analyzing the relationship between student perception of LMS course pedagogical tools usefulness and student LMS course satisfaction. The results on these research question were presented herein accordingly.

Content tool usefulness and Course satisfaction

The first research question was to analyze the relationship between student perception of LMS course content tools usefulness and student LMS course satisfaction. For this, the data were gathered from the survey. The data were analyzed statistically for the significance of correlation among the variables: Content usefulness and Course satisfaction. In the baseline, the results of the Spearman correlation indicated that there was a significant positive association between Content usefulness and Course satisfaction, ($r(26) =0.311$, $p < .05$). In the end-line, the results of the correlation was positive strong and significant ($r(26) =0.558$, $p < .05$).

Communication/collaboration usefulness and Course satisfaction

In this study, the third research question was to analyze the relationship between student perception of LMS communication/collaboration tools usefulness and student LMS course satisfaction. For this, the data were gathered from the survey. The data were analyzed statistically for the significance of correlation among the variables: communication/collaboration tool usefulness and Course satisfaction. In the baseline, the results of the Spearman correlation indicated that there was a significant positive association between Content usefulness and Course satisfaction, ($r(26) =0.241$, $p < .05$). In the end-line, the results of the correlation was positive and significant ($r(26) =0.586$, $p < .05$).

Feedback and support usefulness and Course satisfaction

In this study, the fourth research question was to analyze the relationship between student perception of LMS feedback and support tools usefulness and student LMS course satisfaction. For this, the data were gathered from the survey. The data were analyzed statistically for the significance of correlation among the variables: feedback and support tool usefulness and Course satisfaction. In the baseline, the results of the Spearman correlation indicated that there was a significant positive association between Content usefulness and Course satisfaction, ($r(26) =0.161$, $p < .05$). In the end-line, the results of the correlation was positive and significant ($r(26) =0.492$, $p < 0.05$).

Assessment tool usefulness and Course satisfaction

In this study, the second research question was to analyze the relationship between student perception of LMS assessment tools usefulness and student LMS course satisfaction. For this, the data were gathered from the survey. The data were analyzed statistically for the significance of correlation among the variables: Assessment tool usefulness and Course satisfaction. In the baseline, the results showed that Spearman correlation was not significant between Content usefulness and Course satisfaction, ($r(26) =0.08$, $p >0.05$). In the end-line, the results of the correlation was also not significant ($r(26) =0.335$, $p > .05$).

Subject and Course satisfaction

In this study, the fifth research question was to analyze the relationship between student's perceptions of student LMS course satisfaction within-subject level. For this, the data were gathered from the survey. The data were analyzed statistically for the significance of correlation among the subjects for student's perceptions of student LMS course satisfaction. In the baseline, an independent-samples t-test indicated that scores were statistically equal for Mathematics education students ($M = 12.12$, $SD = 4.71$) and English education students ($M = 11.69$, $SD = 5.01$), $t(24) = 0.21$, $p > 0.05$. In the end line, the scores were significantly higher for Mathematics education students ($M = 16.92$, $SD = 3.56$) than for English education students ($M = 15.69$, $SD = 1.84$), $t(24) = 1.15$, $p < 0.05$.

Gender and Course satisfaction

In this study, fifth research question was to analyze the relationship between student's perceptions of student LMS course satisfaction within gender level. For this, the data were gathered from survey. In the baseline, an independent-samples t-test indicated that scores were statistically equal for Boys students ($M = 10.21$, $SD = 4.32$) and Girl students ($M = 10.85$, $SD = 4.44$), $t(24) = 0.21$, $p > 0.05$. In the end line, the scores were significantly higher for Boys students ($M = 16.78$, $SD = 0.7$) than for Girl students ($M = 15$, $SD = 1.73$), $t(24) = 1.44$, $p < 0.05$.

Discussions and Conclusion

LMS use in education has been a dominant means for educational governance. However, thoughtfully designed pedagogical activities in LMS can only help students learning. Though LMS is useful for education delivery, it is found that the success of LMS largely depends on proper instructional design. This was justified by a version that says technology integration largely depends on how it is implemented (Conole & Dyke, 2004) & further, justified by a work that technology's benefit on student learning depends on how the technology is implemented (Li & Ma, 2010). Therefore, in this study, it is noticed that if pedagogical tools are less interactive within LMS, students would less engaged and less motivated. Therefore, sound pedagogical tools like content tools, assessment tools, communication tools, feedback tools are important to design thoughtfully to enhance students learning.

Based on the result, this study found that students were more satisfied from LMS learning environment when it is designed according to engaged and interactive pedagogical tools: content tools, communication and interaction tools, feedback and support tools. This finding is similar to the version of Educators who suggested that educational technology can strengthen quality instruction and leads to increased student learning (Raines & Clark, 2011). The finding is aligned with the recommendation that says the instructor must use technology to facilitate student learning by using effective learning management principles (Baghdadi, 2011). However, it is agreed with the version that online learners highly value a course when the course content is "well-organized, effectively presented, interactive, clearly written, flexible, right length and breadth" (Ozkan & Koseler, 2009). Therefore a number of educational technology tools need to be part of LMS as suggested by Yueh & Hsu (Yueh & Hsu, 2008).

In this study, it is also found that students were less satisfied from LMS assessment tools. So, assessment tools need to re-design. Constructivism assumes that learning as a function of activities (action). But assessment tool was not based on this principles, so more collaborative type of assessment tools need to design in LMS. The Finding is aligned to Vygotsky's (1978) argument that suggested for social interaction level. The finding supported that learning is active and generated from the interaction between and within people's actions, experiences, and subjective states of mind. It is therefore concluded that "higher the engagement higher the learning" which is also argued in a number of works (Vygotsky, 1986; Vygotsky, 1978; Siemens, 2005; Downes, 2005).

This study found that math students were more satisfied from LMS courseware than English students. Boys students were more satisfied from LMS courseware than Girl students. From the study, it is concluded that LMS need to design with good pedagogical elements like learning resource tools, learning activity tools, assessment tools, communication tools, and feedback tools. Also, gender friendly learning tools are necessary to consider while implementing an online learning environment.

Reflective Lessons Learnt

As a teacher cum researcher, this research study has some noticeable points as lessons to learn. These days, online learning activities are increasing. The digital features are making physical things ease of access. However, during this research study, I learned that LMS alone could not enhance quality learning. Although students use LMS for learning, and they often show very high belief, LMS must be designed with a number of opportunities to build it more engaged and more interactive. LMS should maintain a reciprocal relationship between teacher-student and learning content, therefore creating engaged and interactive learning environment in LMS to accelerate students learning and their course satisfaction.

This study only touched students' perceptions on the use of LMS in their learning. Future studies regarding the use of LMS in learning may be directed at evaluating the various courses in the M. Ed programme. A future study may also necessary to establish the effectiveness and relevance of LMS to visualize higher order learning skills. There is a clear need to explore this topic in greater depth for two reasons. Firstly, the effectiveness of LMS in the context of TU and in the context of Nepal, where ICT is being an inherent part of education. Secondly, the use of LMS helps to support students learning to make it accessible anywhere anytime.

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Comparative study of the effect of Lycra on Single Jersey and 1×1 Rib made from 100% Cotton and Cotton/Lycra Yarns

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Abstract
For an end consumer, the most significant factors are performance and comfort after a few aesthetic factors such as appearance and fashion appeal. For stretchable fabric, the fit related comfort lies the inability of the fabric to be stretched and recover when a repeated load is applied due to body movements without any permanent set. Lycra is one of the best yarn to use in a different field. In this study, the dimensional and physical properties of cotton/Lycra single jersey and rib fabrics are investigated in comparison with fabrics knitted from cotton alone. It is apparent that the presence of Lycra shows improved dimensional and physical properties in both knitted fabrics. Furthermore, it was found that Lycra-containing fabrics tended to have tighter structure, higher weight, thickness, bursting strength and elongation, but air permeability, tensile properties, pilling grade, and shrinkage are lower.

Key Words: Knitted Fabric, Lycra, Fabric Properties, 1×1 Rib, Shrinkage, Tensile Properties

1. Introduction

Stretch fiber, yarn, or fabric provides necessary elasticity for a garment to respond to every movement of the body and return to its original size and shape. The degree and direction of elasticity determine the end use of the stretch garment. The most important property requirements for stretch garment are in the order of body comfort fit, breathability, and durability.

Knitted fabrics are produced by interloping the yarn which can be made from natural, synthetic, or regenerated fibers. The raw material types and structures give different properties for the yarns used in knitting. The variation in yarn properties results in a variation of knitted fabrics properties such as dimensional, mechanical, comfort, and appearance. Mechanical properties, particularly strength and elongation, are the most important performance properties of knitted fabrics which govern the fabric performance in use by causing a change of dimensions of strained knitted fabrics (Eltahan 2016; Sarıoglu and Babaarslan 2017; Makhlouf 2015). A change of dimensions of strained knitted fabric can be defined by increasing dimension in one direction as a dimension in other directions is decreasing (Semnani 2013; Jinyun, Lam, and Xuyong 2010). In many cases, it is important to know how much the knit will deform in one or another direction. But it is known that, in various knitting structures, knitted fabrics are characterized in different extensibility (in a course and wale directions) and maximum force to rupture (Mikucioniene and Mickeviciene 2010; Man 2014). Processes of deformation of knitted fabrics are described in a concept of extensibility of knitted fabric, and the deformation can be determined and influenced by different factors.

As studied in different research results, dimensional and physical properties of knitted fabrics have been investigated by different scholars in relation to yarn types, yarn structure, and knit structures. Concerning the raw materials, the scholars do not yet investigate the comparative effect of Lycra yarn on dimensional and physical properties of single jersey and 1×1 rib knitted fabrics. In this paper, different dimensional and physical properties of single jersey and 1×1 rib knitted fabrics made from 100% cotton and cotton/Lycra blend (96/4 in percentage) is studied by conducting scientific tests and analysis.

2. Materials & Methods

2.1. Materials

Single jersey and 1×1 rib fabrics were knitted having 2.9 mm loop length: with 100% cotton and the other one as cotton/lycra (96%/4%) blended fabrics. Fabric Samples are produced in Mayer & Cie Single Jersey Circular Knitting Machine of 30 dia. & 24 gauge. 30/1 ring spun cotton yarn & 20 Denier Elastane were used in the experiment. An IRO MER2 system was used to feed the elastane, and yarn tension was 6 cN. The samples were subjected to the dyeing, washing, and finishing processes. Table 1 shows the sample specifications used to conduct this research.

Table 1. Sample specification

Sample	Fabric type	Stitch length (mm)	Cotton %	Lycra %
1	S/J	2.9	100%	0%
2	S/J (With Lycra)	2.9	96%	4%
3	Rib	2.9	100%	0%
4	Rib (With Lycra)	2.9	96%	4%

2.2. Methods

Table 2 shows the various testing methods and equipment's used for this experiment. All samples were tested 3 types, and the average was taken under consideration.

Table 2. Testing methods and equipment's

Tests	Methods	Equipment's
Fabric weight	ISO 33071	GSM cutter, Electric balance
WPC & CPC	Manually	Magnifying glass, Needles
Stitch density	Manually	N/A
Pilling	ISO 12945-1:2000	ICI pilling test box
Shrinkage	ISO 6330	Wascator
Bursting	ISO 13938-2 1999	Tru Burst Machine
Spirality	AATCC 179	N/A
Air permeability	ISO 9237	Air permeability tester
Tensile properties	ASTM D5035- 95	MESDAN TENSO Tensile tester

3. Results & Discussion

3.1. Fabric Weight

Table 3. Comparison of GSM

Sample No	GSM (gm/m^2)	Standard deviation	CV%
Single Jersey (Without Lycra)	132.8	1.15	0.86
Single Jersey (With Lycra)	172.8	0.85	0.43
Rib (Without Lycra)	195.8	1.17	0.88
Rib (Lycra)	212.4	0.85	0.44

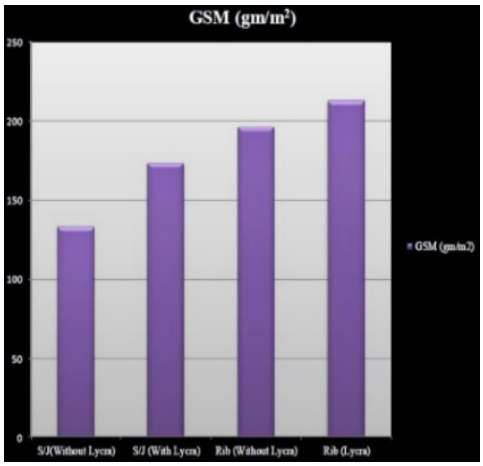

Figure 1. Effect of GSM in Single jersey & Rib (with or without Lycra) from table 3.

From figure 1, the GSM of the samples having 100% cotton is less than the samples which have 4% Lycra with cotton. This is because Lycra in the knitted fabric leads to compacting the fabric together. Lycra in the yarn tends to contract the loops to each other, which decreases loop length, and the amount of elastane increases, making tighter fabric**.** But since rib structure is naturally more compact and heavier than single jersey thus showing higher GSM.

3.2. Fabric Density: Wales / cm (WPC) & Course /cm (CPC)

Table 4. Comparison of Wales/cm and Course/cm

Sample no	Wales/cm	Course/cm
Single Jersey (Without Lycra)	37	52
Single Jersey (With Lycra)	35	59
Rib (Without Lycra)	15	23
Rib (Lycra)	14	26

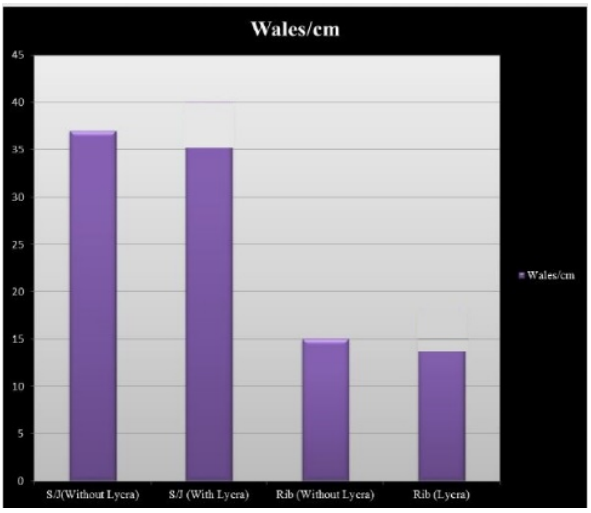

Figure 2. Effect of Wales per cm in Single jersey & Rib from table 4.

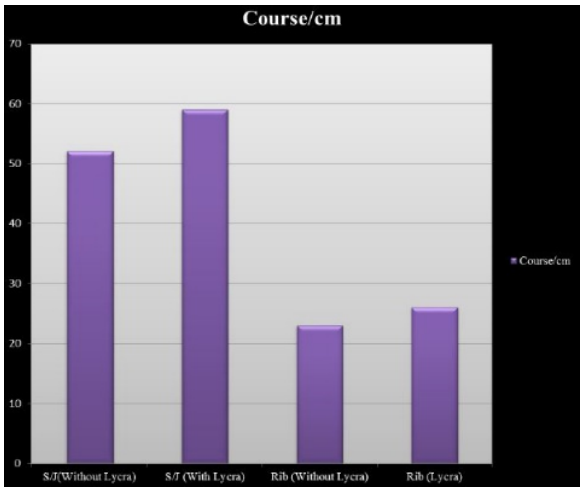

Figure 3. Effect of Courses per cm in Single jersey & Rib from table 4.

From Figure 2, the wales/cm decreases due to the presence of Lycra in the fabric. This is because Lycra in the yarn tends to contract the loops to each other. From Figure 3, by adding Lycra in the knitted fabrics, the course density increases. This is already very clear since Lycra tends to contract the loops to each other, causing less number of wales/cm, which in turn increases the course/cm of the fabric containing Lycra. Due to the compact structure of rib fabric, it shows less number of course and wales per cm than that of the single jersey.

3.3 Loop shape factor

Table 5. Comparison of the loop shape factor

Serial no	Kc	Kw	Loop shape factor
Single Jersey (Without Lycra)	4.9	3.36	1.45
Single Jersey (With Lycra)	6.72	4.56	1.47
Rib (Without Lycra)	3.84	2.88	1.33
Rib (Lycra)	6.24	3.84	1.62

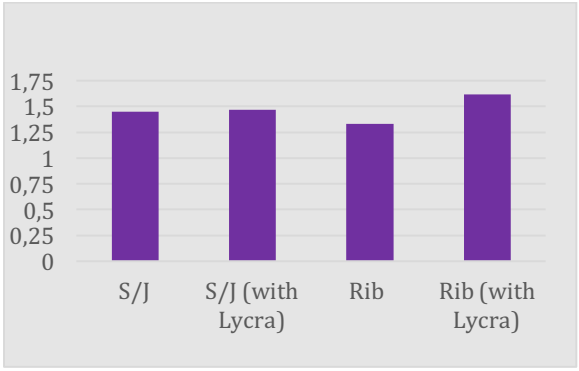

Figure 4. Effect of loop shape factor in Single jersey & Rib from table 5.

From figure 4, Loop shape factor increases as loop length decrease. The effect of Lycra on loop shape factor is similar to the effect on the course and wales density. As the Lycra tends to contract the loops to each other, the loop shape factor Kc/Kw increases for fabric containing Lycra.

3.4 Stitch Density

Table 6. Comparison of stitch density

Sample no	Wales/cm	Course/cm	Stitch density=WPCXCPC
Single Jersey (Without Lycra)	37	52	1924
Single Jersey (With Lycra)	35	59	2065
Rib (Without Lycra)	15	23	345
Rib (Lycra)	14	26	364

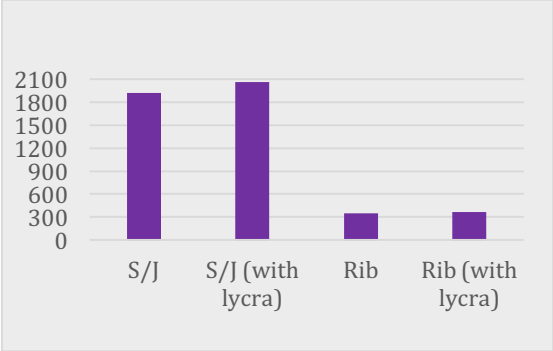

Figure 5. Effect of stitch density in Single jersey & Rib from table 6.

From the figure 5, stitch density of fabrics containing Lycra is higher than 100% cotton-containing fabric as the courses/cm increases with the decreases of wales/cm as the Lycra tends to contract the loops to each other. Due to the compact structure of rib fabric, it shows less stitch density than single jersey.

3.5 ICI Pilling Test Report

Table 7. 100% cotton single jersey 30 Ne

Serial no.	No. of cycles	Rating in Wales direction	Avg. rating in Wales direction	Course direction	Avg. rating in Course direction
1.	14400	4	4	4	4
2.	14400	4		4	

Table 8. 30/1 cotton (96%) and 20D Lycra (4%) S/J

Serial no.	No. of cycles	Rating in Wales direction	Avg. rating in Wales direction	Course direction	Avg. rating in Course direction
1.	14400	4	4	4	4
2.	14400	4		4	

Table 9. 100% cotton Rib 30 Ne

Serial no.	No. of cycles	Rating in Wales direction	Avg. rating in Wales direction	Course direction	Avg. rating in Course direction
1.	14400	3	3	3	3
2.	14400	3		3	

Table 10. 30/1 cotton (96%) and 20D Lycra (4%) Rib

Serial no.	No. of cycles	Rating in Wales direction	Avg. rating in Wales direction	Course direction	Avg. rating in Course direction
1.	14400	3	3	3	3
2.	14400	3		3	

Tables 7-10, show the differences between pilling of single jersey and rib fabric containing Lycra with that of 100% cotton is too insignificant. But there exists a difference between S/J and rib fabrics. Generally, fabric tends to pill a little more along the wales than courses. Moreover, the plain knitted fabric generally produced flatter pills lying closer to the fabric surface as well as having less abrasion effect compared to the 1x1 rib fabric whose pills were also fluffy due to having a higher abrasion effect.

Table 11. Observation of shrinkage percentage

Sample no.	Shrinkage in length direction	Shrinkage in width direction
Single Jersey (Without Lycra)	-5.1	-4.6
Single Jersey (With Lycra)	-4.0	-2.0
Rib (Without Lycra)	-3.5	-2.5
Rib (Lycra)	-2.0	-1.6

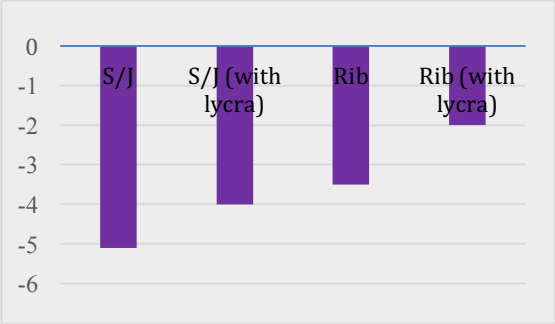

Figure 6. Effect of Shrinkage Percentage in a lengthwise direction from table 11.

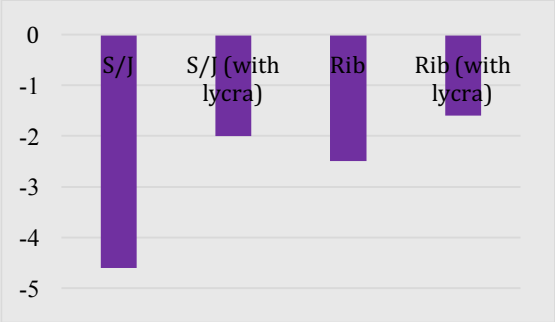

Figure 7. Effect of Shrinkage Percentage in widthwise direction from table 11.

From figure 6 & 7, shrinkage percentage of cotton/lycra fabrics is less than that of 100% cotton fabrics. Because Lycra containing yarn helps to retain the fabric's original dimension as far as possible after washing. On the other hand, since rib fabric is more compact and tightly held balanced structure than that of single jersey, so it shows lower shrinkage.

3.7. Bursting Strength Test

Table 12. Comparison between these samples

Sample no.	Bursting strength (KN/m^2)	CV% of bursting strength
Single Jersey (Without Lycra)	124.1	6.45
Single Jersey (With Lycra)	154.3	2.91
Rib (Without Lycra)	162.1	5.45
Rib (Lycra)	176.1	2.88

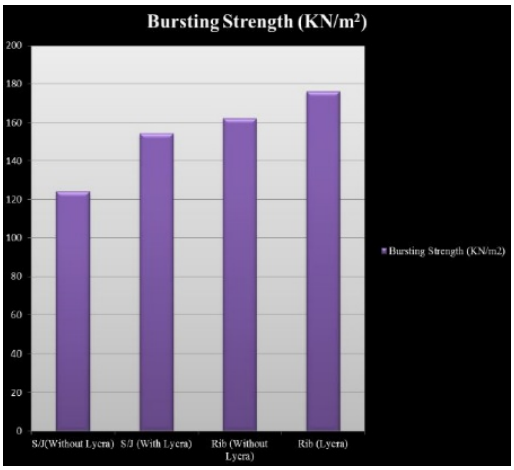

Figure 8. Effect of bursting strength (KN/m2) in Single jersey & Rib from table 12.

Figure 8 shows that the bursting strength of cotton/lycra fabric is higher than the 100% cotton s/j and rib because the use of Lycra yarn causes the increase of the strength of the fabric which results in higher compactness of the fabric structure thus resisting the bursting force.

3.8. Air Permeability Test

Table 13. Air permeability test results

Sample	Air Permeability (l/m²/s)
Single Jersey(Without Lycra)	556
Single Jersey(With Lycra)	30.6
Rib (Without Lycra)	633
Rib (With Lycra)	89.7

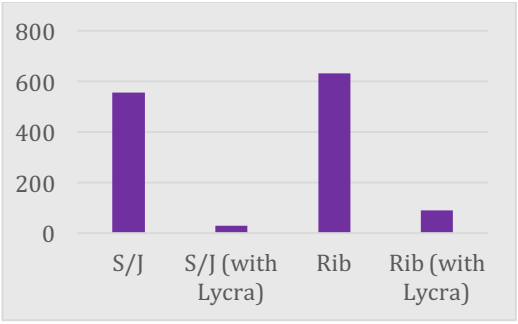

Figure 9. Bar chart showing the air permeability from table 13.

Figure 9 shows, fabric porosity, has a reflection on the air permeability, that is, as the porosity of the fabric increases the air permeability of fabric also increases (Prakash 2010). As shown in Figures 9, the air permeability of a single jersey is lower than the rib. This is because rib1x1 is more stable fabric from shrinkage as compared to single jersey and the air is applied at the face and reverse stitches equally. The other reason for the two fabrics having different air permeability is rib fabrics have high resistance to robbing back of yarn during knitting. This resistance helps the needles to obtain long yarn during knitting (Sitotaw 2016). Instead, fabrics containing Lycra shows more compact structure due to elastic property Lycra, which in turn decreases the air permeability.

3.9. Spirality Test

Table 14. Comparison between these samples

Sample	Spirality (%)
Single Jersey(Without Lycra)	2.5
Single Jersey(With Lycra)	2.0
Rib (Without Lycra)	1.9
Rib (With Lycra)	1

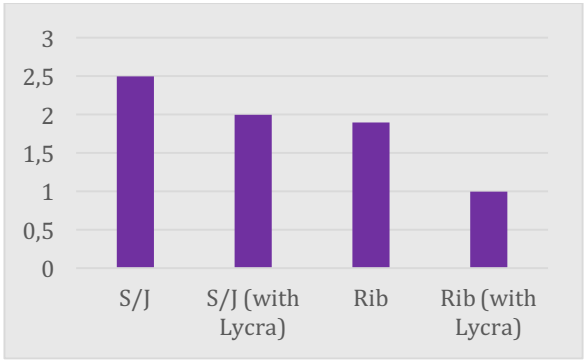

Figure 10. Effect of Spirality in Single jersey & Rib from table 14.

Figure 10 shows that Spirality of single jersey fabric made of 100% cotton is higher than rib fabric this is because single jersey fabric is open knitted structure thus the yarn has a higher tendency to rotate inside the fabric after relaxation while in a closed knitted structure the movement of a knitted loop is restricted, and thus the Spirality is reduced in rib fabric. Since a single jersey structure is highly unbalanced. The forces created by interlacing loops are substantially different on the technical face and technical back due to the fact that loops are continuously formed in one direction only (Spencer 2001). This creates different forms and levels of forces on the two fabric faces. The main reason for achieving lower values of distortion in 1x1 rib because its structure is perfectly balanced. Instead, fabric samples containing Lycra shows less Spirality since Lycra tends to bend the loops towards each other making fabric closer knitted structure which lowers Spirality.

3.10. Tensile property test

Table 15. Lengthwise Tensile properties of single jersey knitted fabrics

Fabric composition	Tensile strength (N)
100% cotton	285.7
Cotton/ Lycra (96%/4%)	193.6

Table 16. Widthwise Tensile properties of single jersey knitted fabrics

Fabric composition	Tensile strength (N)
100% cotton	175.8
Cotton/ Lycra (96%/4%)	211.4

Table 17. Lengthwise Tensile properties of 1×1 rib knitted fabrics

Fabric composition	Tensile strength (N)
100% cotton	375.3
Cotton/ Lycra (96%/4%)	267.5

Table 18. Widthwise Tensile properties of 1×1 rib knitted fabrics

Fabric composition	Tensile strength (N)
100% cotton	147.3
Cotton/ Lycra (96%/4%)	103.1

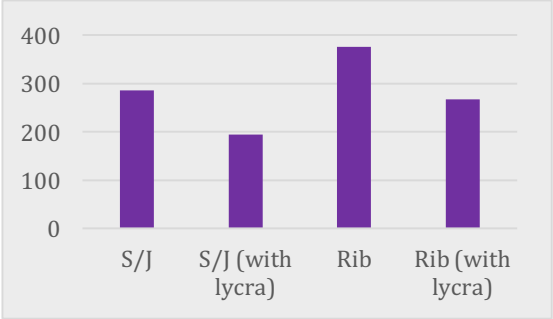

Figure 11. Effect of lengthwise tensile strength in Single jersey & Rib

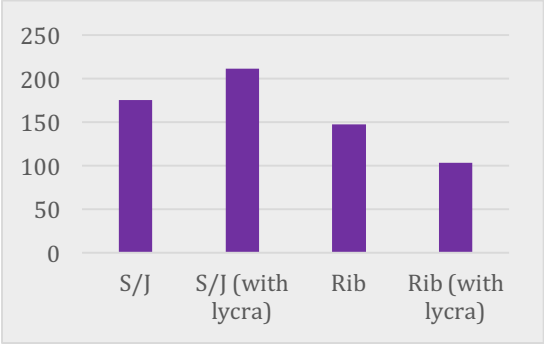

Figure 12. Effect of widthwise tensile strength in Single jersey & Rib

Data obtained from tables (15-18) and as shown in Figure 11 & 12, the maximum force needed to break the fabrics is different. Single jersey and 1×1 rib knitted fabrics made from 100% cotton have high breaking force in lengthwise as compared to fabric made from cotton/Lycra blended yarns. After adding the Lycra yarn, the maximum braking force in the lengthwise of the single jersey decreased as compared to its widthwise breaking force because of the high elongation percent in the lengthwise direction of the fabric. Single jersey knitted fabric has high extension characteristic in the lengthwise than widthwise direction. Fabrics with high extension property need low force to extend, and its strength becomes decreased (Sitotaw and Adamu 2017). Lengthwise breaking strength of 1×1 rib knitted fabrics is higher than single jersey's both lengthwise and widthwise breaking strength due to the balanced structure of rib. But, the widthwise strength of 1×1 rib is lower than the single jersey's lengthwise and widthwise strength because of the high elongation percent in the widthwise direction of the fabric.

4. Conclusion

From this research, the comparative effect of Lycra on Single Jersey and 1×1 Rib Knitted Fabrics made from 100% Cotton and Cotton/Lycra Yarns were observed. The key findings are, the weight and thickness of Cotton / Lycra fabrics are higher, but air permeability and the degree of Spirality are lower than 100% Cotton knitted fabrics respectively. Furthermore, Shrinkage of Cotton / Lycra fabrics is lower than fabrics made of 100% Cotton. Lycra containing fabric shows higher bursting strength. Having lower tensile strength towards the lengthwise direction in Cotton/ Lycra fabrics which on the contrary shows higher tensile strength in widthwise direction for single jersey cotton/ Lycra fabric because of high elongation percentage in the widthwise direction of the fabric. Depending on the quality of the end product, this research results can be beneficial.

5. Data Availability:

The data used to support the findings of this study are available from the corresponding author upon request.

6. Conflict of Interest:

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Measurement of Standard Time Work with the Predetermined Motion Time System Method at the Production Department in PT.PIJ Sidoarjo

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Abstract
The purpose of this study is to measure standard work time in the production section at "PT. Prestasi Ide Jaya" (PT.PIJ) where there are several workers and machine operators, if between one of the operators on each machine does not work properly it will cause the production process to stop. In this study there are two variables, namely 1) the dependent variable is the time and movement of the machine operator, 2) the independent variable of several Therblig movements: a. reach out, b. take off, c. holding, d. direct, and e. transport. Measuring the standard time of operator movements with Work Factor and Time Measurement Methods. The calculation results can be concluded that the Time Measurement (MTM) and Work factor (WF) methods can provide a standard time that is following the standard time that is smaller than real conditions. Company is proposing to reduce operator movements that are not needed in the production process.

Keywords: Methods Time Measurement, Work factor, Standard Time Work

1. Introduction

Standard time is the time needed by a worker who has an average ability level to complete a job. Standard time measurement is divided into two parts, namely direct measurement and indirect measurement. According to Wignjosoebroto (2003) in Febriana (2013), work time measurement is a method of balance between human activities contributed by the unit of output produced. The measurement of work time is related to efforts to determine the standard time needed to complete a job. PT. PIJ is one of the companies engaged in the manufacturing industry with the products produced are sandals and EVA sponges that are used for flip flops products. In the process of producing EVA sponges, they still use machines with the help of human power. Parts of eva sponge production are 17 workers and 7 machine operators, if between one of the operators in each machine does not work properly it will cause the production process to cease and it will also cause a buildup in each machine, thus inhibiting the production process.

2. Method

2.1 Research Method

Observations were done by direct observation to PT. PIJ and conducting interviews with relevant parties to support data originality. Data retrieval is done by observing directly the production process site and the ongoing production process. Data of observations carried out were processed in March 2017. The data needed is data on the number of operators, standard time data from operator movements from each production machine in seconds. Data that has been collected, data processing is carried out by using measures to determine the maturity of the machine operator. Calculations to find out my suitable time using the Work Factor method and Method Time Measurement. As for the smooth running of the production process so that the calculation of cycle time, normal time and standard time is carried out. After that, an analysis of the standard time calculation is carried out by comparing the results obtained from the calculation between using the WF and MTM methods with the methods used by the company. From the results of the analysis obtained, the proposed improvements to the methods applied by the company are made, namely Work Factor methods and Time Measurement Methods

2.2 Literature Study

Working Time Measurement
Time Study is basically an attempt to determine the length of work time required by an operator to complete a job (Niebel, 1988 in Rinawati et al, 2012). Whereas Wignjosoebroto (2006) suggests that work time measurement is a method of determining the balance between human activities contributed by the unit of output produced. Basically, the measurement of working time is divided into two parts, namely direct measurement of work and indirect measurement of work. The first way is called because the measurement is carried out directly, namely where the measured work is carried out. Two ways include the method of measuring work using stopwatch time study and work sampling. While the measurement of indirect work can be done without having to go to the workplace as long as knowing the work through the elements of work or elements of the movement. This method can be done in standard time data activities (data standards) and time movement data (predetermined systems) Wignjosoebroto (2006).

Methods Time Measurement (MTM)
Wignjosoebroto (2006) suggests that the measurement of time methods in foreign terms better known as Time Measurement Methods (MTM) is a predetermined time standard system that is developed based on the study of image work movements of an industrial work operation recorded in film. This system is defined as a procedure to analyze each operation or work method into the basic movements needed to carry out the work, and then set the standard time of each movement based on the type of movement and working conditions of each existing.
Work Factor

Wignjosoebroto (2006) suggests that work factors are one of the systems of the earliest Predetermined Time System and are widely applied. This system makes it possible to set the time for manual works using predetermined movement time data. The first step is to make a detailed analysis of each work step based on four basic variables (limbs, motion transfer work, manual control, and existing weight / obstacles) and use the work unit factor as a measurement. The next step is to set the standard time of movement for each of the identified work movements. Of course, in determining the standard time for work in total, you still have to add it to the allowance time needed.

This is the formula to calculate cycle time, normal time, and standard time (rinawatikk, 2012):

Cycle Time

$$X = \frac{\sum x}{n}$$

X is the Symbol for Cycle Time
$\sum \boldsymbol{x}$ is the symbol for Observation Time

n is the symbol for Numbers of Observation

Normal Time
Wn= Total Time x *performance rating* (%)

Wn is the symbol for normal time
Performance Rating is an assessment of the performance of the operator p = 1 if the operator works normally, p <1 if the time is broken, p> 1 if it is too fast.

Standard Time
Standard Time = Normal Time + (*Normal Time* + *Allowance* %)

$$StandardTime = NormalTime \times \frac{100\,\%}{100\,\% - allowance\,\%}$$

Chart
The Chart or simultaneous motion (simo) chart is a type of chart that is often used in movement studies as a tool for recording and analyzing an activity. This chart is used to analyze work that describes the simultaneous movements of both hands. From this chart, it will be known how the activities of each hand, and can be analyzed whether the effectiveness of the movement can be increased by eliminating, replacing, or combining motion (Herjanto, 2008).

Job Description : measurement of the side of the lid
Department : Measurement
Map Number :
Recent [V] Proposal [ ]
Mapped By : Michael Ronald
Date : March 17, 2011

Left Hand	Distance (m)	Time (Second)	Symbol		Time (Second)	Distance (m)	Right Hand
unemployed	2	4	D	Re	4	2	Reaching Fiber
unemployed		2	D	G	2		Holding fiber
unemployed		6	D	M	6		Bring Fiber
Reaching the Ruler	0.41	3	Re	Re	3	0.4	Reaching Markers
Holding the Ruler		2	G	G	2		Holding fiber
Bring the Ruler		4	M	M	4		Bring Markers
Directing the ruler to the board		3	P	P	3		Directing Markers
Hold the Ruler		28	U	U	28		Using Markers
Hold the Ruler		3	Ri	Ri	3		Release the Markers

Figure 1. The Example of Simo Chart (Source: Herjanto, 2008)

3. Results and Discussion

3.1 Result

All data collected has been calculated using the method applied by the company. Data on the standard time of operator movement on each machine in the eva sponge production process in one production process at PT.PIJ is as follows:

Table 1. Time Standard Data of Operator Motion of the Company

Machine Type	Operator Motion Type					Time Total for Operator Motion (Sec/unit)
	Reaching (sec/unit)	Holding (sec/unit)	Directing (sec/unit)	Release (sec/unit)	Carry (sec/unit)	
1. **The operator of Kneder 1**	4,78	1,5	-	1,5	11,46	19,24
2. **The operator of Roll 1**	1,4	1,5	2,82	1,5	2,23	9,45
3. **The operator of Cutting roll 1**	2,3	1,5	2,45	1,5	2,1	9,85
4. **The operator of Kneder 2**	4,87	1,5	-	1,5	7,56	15,43
5. **The operator of Roll 2**	1,4	1,5	2,82	1,5	2,23	9,45
6. **The operator of Cutting Roll 2**	2,3	1,5	2,45	1,5	2,1	9,85
7. **The operator of Press**	1	1,5	2,25	1,5	2,4	8,65
Time Total						81,92

(Data Source: PT.PIJ)

Standard Time Data Processing with Work Factor Method

Based on calculations with the Work Factor method, it can be seen that the Work Factor method obtained a total standard time of operator motion in each machine that is smaller than the method used in the company can be seen in the table below:

Table 2. Operator Motion Sandart Time Data with Work Factor Method

Machine Operator	Operator Motion Type					Time Total for Operator Motion (Sec/unit)
	Reaching (sec/unit)	Hold (sec/unit)	Directing (sec/unit)	Release (sec/unit)	Carry (sec/unit)	
1. **The operator of Kneder 1**	3,135	0,72	-	0,72	6,817	11,43
2. **The operator of Roll 1**	1,26	0,48	0,435	0,48	3,21	5,86
3. **The operator of Cutting roll 1**	0,63	0,24	0,435	0,24	1,605	3,15
4. **The operator of Kneder 2**	2,595	0,6	-	0,6	4,89	8,75
5. **The operator of Roll 2**	1,26	0,48	0,435	0,48	3,21	5,86
6. **The operator of Cutting Roll 2**	0,63	0,24	0,435	0,24	1,605	3,15
7. **The operator of Press**	0,63	0,24	0,525	0,24	1,605	3,24
Time Total (sec/unit)						41,44

(Source: Result of Data Processing)

Raw Time Data Processing with Time Measurement Methods

Based on calculations with the Methods of Time Measurement method, it can be seen that the Methods of Time Measurement method shows that the total standard time of operator movements on each machine is smaller than the method used in the company, which can be seen in the table below:

Table 3. Operator Motion Sandart Time Data with *Time Measurement Methods*

Machine Operator	Operator Motion Type					Time Total for Operator Motion (Sec/unit)
	Reaching (sec/unit)	Hold (sec/unit)	Directing (sec/unit)	Release (sec/unit)	Carry (sec/unit)	
1. **The operator of Kneder 1**	4,743	1,971	-	0,54	10,158	17,41
2. **The operator of Roll 1**	1,566	1,314	0,252	0,36	3,438	6,93
3. **The operator of Cutting roll 1**	1,566	1,314	0,252	0,36	3,438	6,93
4. **The operator of Kneder 2**	3,73	1,642	-	0,45	8,559	14,52
5. **The operator of Roll 2**	1,566	1,314	0,252	0,36	4,68	8,17
6. **The operator of Cutting Roll 2**	1,566	1,314	0,252	0,36	4,68	8,17
7. **The operator of Press**	1,566	1,314	0,252	0,45	4,374	7,87
Time Total (sec/unit)						70

(Source: Result of Data Processing)

The following is to clarify the total standard time of operator movements by using the Work Factor method and Methods Time Measurement compared to the factory standard time:

Table 4. Comparison of Factory Standard Time with WF and MTM Methods

Machine Operator	Factory Standard Time (Sec/unit)	*Work Factor Method* (sec/unit)	*Methods Time Measurement* (sec/unit)
1. The operator of Kneder 1	19,24	11,43	17,41
2. **The operator of Roll 1**	9,45	5,86	8,17
3. **The operator of Cutting roll 1**	9,85	3,15	8,17
4. **The operator of Kneder 2**	15,43	8,75	14,52
5. **The operator of Roll 2**	9,45	5,86	8,17
6. **The operator of Cutting Roll 2**	9,85	3,15	8,17
7. **The operator of Press**	8,65	3,24	7,87
Time Total (Second)	81,92	41,44	70

(Source: Result of Data Processing)

3.2 Discussion

Based on calculations with the two methods, namely the Work Factor method and Time Measurement methods, it can be seen that the Work Factor method obtained a total standard time of operator movements on each smaller machine, namely the kneder 1 for reaching (3.135 seconds), holding (0.72 seconds), release (0.72), and

transport (6.817 seconds), for roll machine 1 movement reaches (1.26 seconds), holds (0.48 seconds), directs (0.435 seconds), releases (0.48) , and transporting (3.21 seconds), 1 movement reaching a roll roll machine (0.63 seconds), holding (0.24 seconds), directing (0.435 seconds), releasing (0.24), and transporting (1.605 seconds) , kneder machine 2 for reaching (2.595 seconds), holding (0.6 seconds), releasing (0.6 seconds), and transporting (4.89 seconds), for roll 2 movement machines reaching (1.26 seconds), holding (0.48 seconds), directing (0.435 seconds), releasing (0.48 seconds), and transporting (3.21 seconds), the 2 movement cutting roll machine reaches (0.63 seconds), holds (0, 24 seconds), directing (0.435 seconds), releasing (0.24), and transporting (1.605 seconds), and for the press machine the movement reaches (0.63 seconds), holds (0.24 seconds), directs (0.525 seconds) , removing (0.24), and transporting (1.605 seconds) then the total operator movement time of the whole machine is 41.44 seconds.

As well as the Methods of Time Measurement method, the standard time of movement of the operator on each machine is obtained, namely kneder machine 1 for reaching (4.743 seconds), holding (1.971 seconds), releasing (0.54), and transporting (10.158 seconds), for roll 1 reaching (1,566 seconds), holding (1,314 seconds), directing (0,252 seconds), releasing (0,36 seconds), and transporting (3,438 seconds), 1 roll cutting machine reaching (1,566 seconds), holding (1,314 seconds), direct (0.252 seconds), release (0.36 seconds), and transport (3.438 seconds), kneder engine 2 for reaching (3.73 seconds), holding (1.642 seconds), releasing (0.45 seconds), and transporting (8.559 seconds), for roll 2 movement reaching (1.566 seconds), holding (1,314 seconds), directing (0.252 seconds), releasing (0.36 seconds), and transporting (3.438 seconds), cutting roll 2 movement reaching (1.566 seconds), holding (1.314 seconds), directing (0.252 seconds), releasing (0.36 seconds), and transporting (3.438 seconds), and for press machines s reaching range (1.566 seconds), holding (1.314 seconds), directing (0.252 seconds), releasing (0.45), and transporting (4.374 seconds) then the total operator movement time of the whole machine is 70 seconds.

With a standard time that is smaller than the factory default time, the Time Measurement Methods (MTM) and Work factor (WF) methods can provide a standard time that is following the standard time produced smaller than the real conditions in the company. So that the proposed standard time calculation method is accepted and the researcher can suggest using both methods namely Time Measurement Methods (MTM) and Work Factor methods because both of these methods are following the operator's movement of each machine and produce a smaller standard time than the factory default time. So, in this case the researchers suggest reducing operator movements that are not needed in the production process.

4. Conclusion and Recommendation

Conclusions

Based on the results of the study, it can be concluded that the two methods are by Work Factor and Time Measurement Methods have a standard time that is smaller than the factory default time, then the Work factor (WF) method can provide a standard time of movement following the standard time produced more small from real conditions in the company.

Recommendations

The suggestions that can be given by the author in this study are as follows:
1. Time Measurement Methods and Work Factor methods should be used as material for consideration in measuring the standard time of operator movements on each machine in the production process because this method can provide a smaller standard time and by the operator's movements, to minimize production completion time.
2. For the measurement of the standard time of the operator's movement on each production machine, the company should need to consider the operator's movement on the engine during the production process to determine the most effective method

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Analytics Software Languages for Problem Solving

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Abstract
This paper discusses how R Python SPSS and SAS can be used in research and the benefit that it would have to company's futures. By using stable forecasting, investors can predict the future bank failures. By using these software packages, organizations can govern the life cycles of their inquiries and be strategic in their in their future financial stability of an organization. This paper also discusses how each software can be used in different manners to determine the future financial stability of an organiation.

Keywords: R, Python, Excel, SPSS, SAS, MINITAB, Software Programs, Globalization

Introduction

R, Excel, SAS, SPSS and Python are five software programs designed to run statistical analyses and output graphics, can be used for organiational research. R can run on any operating system, is open-source, and reflects many of the changing field preferences. It is also highly standardized. SAS is a paid software system that provides high performance analytics for banking research. Organizations can identify, investigate, and govern the life cycle of their inquiries. When it comes to data science one of the most common points of debate is R vs SAS vs Python vs Excel vs SPSS. It is a well-known fact that R, Python, Excel, SPSS and SAS are the most important five languages to be learned for data analysis.

When it comes to data science one of the most common points of debate is R vs SAS vs SPSS vs. Python. We should also include Excel, because, It does all of the functions that the other four programing languages provide. It is a well-known fact that R Python SPSS and SAS are the most important 4 programming languages to be learned for data analysis by data scientists. However, we can also utilize Excel, to perform most of the operations, especially the simple ones. Excel can be purchased when you purchase or download from Microsoft windows website.

In banking research, there are many software packages are being used including R, Python, SPSS and SAS. Among these packages Python and R open source, free of charge software programming languages. However SAS and SPSS are paid for by licensing companies or universities. (C. Ozgur et.al 2017)

SAS Programming Language

It is a programming language where the input language common spreadsheets as input mechanisms to generate output based on the results of statistical analysis in the form of tables and graphs as RTF PDF, HTML documents. It is an expensive language that is not affordable by most data scientists. Unless the organization helps individuals with financial aid, they will not be able to use SAS. However, both R and Python are free of charge, they could be accessed by anyone, anywhere. This is a biggest advantage of to all data scientists for using both R and Python free of charge.
Classroom and Online Training for Certifications *https://www.edupristine.com/*

SPSS Programming Language

It is also a programming language where the input language common spreadsheets as input mechanisms to generate output based on the results of statistical analysis but the difference from SAS is that the programming language for SPSS is easier to learn and more similar to Excel. However, just like SAS, it is not free of charge. However, we are able to solve large scale problems. *https://www.edupristine.com/*

Python Programming Language

It is another programming language free of charge like R. It is another open source programming language, free to access by everyone. Its code is easier to learn than R or SAS. Python is easier programming language to learn than both. *https://www.edupristine.com/*

R Programming Language

R It is an open source programming language, free to access and pen to all to perform data analysis tasks. It is supported by the R Foundation for basically Statistical Computing. The R language is widely used among data miners for developing statistical software and data analysis. The source code for the R software environment is written primarily in C, FORTRAN, and R. Language R is freely available under the GNU General Public License and is pre-compiled binary versions that are provided for various operating systems. While R has a command line interface, there are several graphical front-ends also available.
Classroom and Online Training for R is provided under Certifications *https://www.edupristine.com/*

Excel

It also can be used to solve simple problems that other programs can solve. We can also utilize Excel, to perform most of the operations, especially the simple ones. Excel can be purchased when you purchase or download from Microsoft windows website (Microsoft, 2019)

MINITAB

Minitab is another software programming language that can utilize all of the benefits of other programming languages such as R, Python, Excel, SAS and SPSS. Currently Minitab is at its 18th edition. However, it is not only at its 18th edition, but using Minitab is also a good additional teaching tool. We can utilize this basic software that is similar to Excel because it has similar instructions. As opposed to R and Python being free of charge, MINITAB costs a modest amount more specifically $100 non-renewing price for instructors and a 6-month rental for $29.99 total and a 12-month rental for $49.99 total for students. Not only are we able to utilize the software by providing Excel-like instructions, with MINITAB, we can create macros that can be used in teaching or research.

R

The software grew in popularity in response to the increasing overall demands on big data analytics and the need for programs which could handle massive data files. This changed how computational data could be handle done; the availability of a new and versatile tool is apt to reframe at least a portion of the discussions around calculation

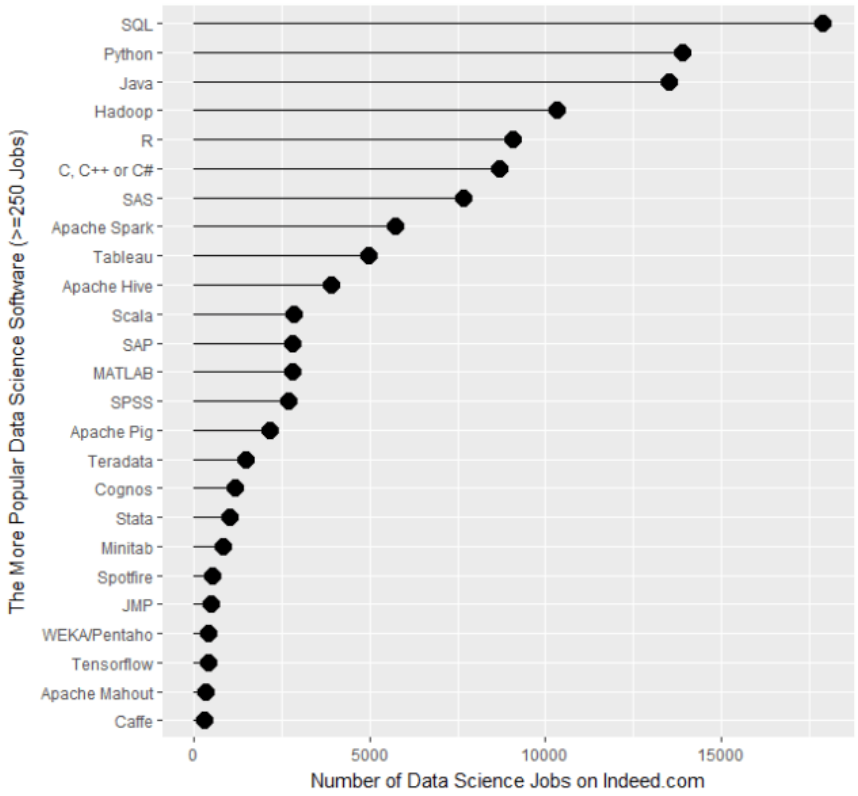
and application of R . For example, Rickert (2014) notes that there were at least 70 separate finance packages available in 2014.

R's flexibility as a software means that it is fully able to perform the necessary tasks for financial analytics. There have been several programs written to facilitate the usage of R in such a setting; one of the most popular is jrvFinance (Trajanov, 2017). This package, alongside the standard tools of R and the bundle package Rmetrics (Trajanov, 2017), allows users to perform the necessary standard financial computations in the software. The largest advantage of this program is that it is set up to mimic the Excel format, allowing familiarity with the system. As Varma (2016) notes in his overview of the jrvFinance package, there are several specific commands to ensure that the correct operations are being performed.

R's Growth and Comparison to Other Software

R's growth in the data analytics field has come to surpass SAS, SPSS, Stata, and MatLab, leading to an increase in job postings where applicants must know how to use R. The overall trend of R is observable in Figure 1, stated from Muenchen (2017).

Figure 1. Number Of Data Science Jobs Posted On A Job Search Website With Over 250 Job Hits



SAS & R for banking and finance

Continuous innovation(https://www.sas.com en_ph/news/press-releases/2017/january/2016-financials.html) Analysts named SAS a leader in predictive and advanced analytics, customer intelligence, data management, data integration and data quality. According to IDC, SAS holds a 31.6 percent share of the advanced and predictive analytics market.[2] SAS has also been recognized by industry analysts as a leader in fraud detection, risk and retail analytics. (Cary, 2017).

Maintaining this leadership is heavily dependent upon innovation. Year after year, SAS reinvests about twice the average of major technology firms into R&D – 26 percent in 2016. This unwavering commitment to innovation is behind the ground-breaking new SAS Viya technology – dubbed by analysts as changing the industry. SAS

continues to introduce new innovation around this open and cloud-ready high-performance analytics and visualization platform – most recently with SAS Visual Investigator, which marries advanced analytics with dynamic and interactive visual workspaces. With it, organizations can identify, investigate and govern the entire life cycle of an investigation, search or inquiry. SAS plans to introduce even more to the SAS Viya family in the first quarter of 2017. (Cary, 2017).

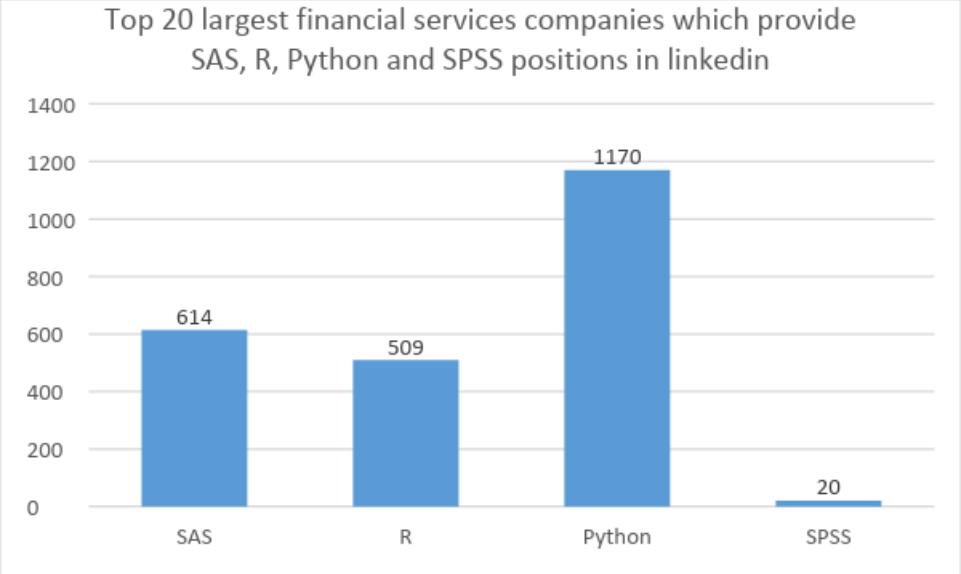
Looking further ahead in 2017, SAS will continue innovation in its core focus areas, including analytics, visualization, data management, customer intelligence, risk and fraud. Additionally, SAS Viya, artificial intelligence, cloud and it will be strong investment areas for SAS. (Cary, 2017).

Table 1. SAS vs R vs Python vs SPSS

SAS	R	Python	SPSS
614	509	1170	20

For example the following figure shows the companies in financial services that utilize SAS, SPSS, Python and R.

Figure 2. Top 20 Largest Financial; Services Companies With SAS, Pythom, R & SPSS



We can also show how largest financial services companies utilize SAS, SPSS, R, Python as the top software packages on LinkedIn

Top 20 largest financial services companies which provide SAS, R, Python and SPSS positions in LinkedIn (https://www.forbes.com/global2000/list/
https://en.wikipedia.org/wiki/List_of_largest_financial_services_companies_by_revenue)

Deposit insurance is a key element in modem banking, it guarantees the financial safety and stability of the depository financial institutions. If an insured depository institution fails to fulfill its obligations to its depositors, the insuring agency will step in to honor the principal and accrued interests. (Dar-YehHwang Cheng F.Lee K.Thomas Liaw

Table 2. Word's Largest 20 Banking & Insurance Companies

Rank	Company	Industry	Headquarters
1	Berkshire Hathaway	Conglomerate	United States
2	AXA	Insurance	France
3	Allianz	Insurance	Germany
4	ICBC	Banking	China
5	Fannie Mae	Investment Services	United States
6	BNP Paribas	Banking	France
7	Generali Group	Insurance	Italy
8	China Construction Bank	Banking	China
9	Banco Santander	Banking	Spain
10	JP Morgan Chase	Banking	United States
11	Société Générale	Banking	France
12	HSBC	Banking	United Kingdom
13	Agricultural Bank of China	Banking	China
14	Bank of America	Banking	United States
15	Bank of China	Banking	China
16	Wells Fargo	Banking	United States
17	Citigroup	Banking	United States
18	Prudential	Insurance	United Kingdom
19	Munich Re	Insurance	Germany
20	Prudential Financial	Insurance	United States

Conclusion

In this paper we showed how software packages R, SAS, Python, SPSS and MINITAB, Excel can be utilized in research. We also give a example in banking and financial services utilize these software packages. However, the most important part of this paper is that it provides cost structure for each software package and how R and Python are open source software programs and prepackaged programs can be easily accessed on the internet or books provide the information needed for those two software packages under free of charge or very inexpensive conditions for both R and Python, The cost structure for the other four software packages are shown. While SAS and SPSS can solve larger problems, it does come in with a certain cost structures as shown in the paper above. On the other hand, Excel is available if someone purchases Microsoft. As with R and Python, there are prepackaged software programs for Excel. However, compared to SPSS or SAS, Excel can only solve problems at a much smaller scale. Perhaps, the problems it solves would be available for small businesses. MINITAB is similar in structure to SPSS and Excel, from a cost standpoint it is much cheaper than SPSSS or SAS. However, even though it can't solve as large of a problems in SAS or SPSS, it can solve problems larger then solvable by Excel. Perhaps, it is suitable for small or medium size firms.

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Predicting The Time And Cost of Fireboat Construction Using Earned Value Method (EVM)

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Abstract
Companies located in Surabaya which are mainly engaged in the production of commercial vessels, providing ship repair and maintenance services as well as general engineering with order-based specifications often experiencing problems of delays and cost overruns because of lack of supervision. Along with the development of the technology industry, ship production requires every shipyard to evaluate their system. Poor performance and lack of control and supervision have caused delays in the construction of new vessels. By using an Earned Value Method (EVM) calculation, it can predict the completion time and the remaining costs of fireboat construction, find deviations between plans and reality, and encourage to look for the causes. Based on the calculation analysis results of the fireboat construction, the researcher predicts the cost of remaining work as Rp. 23,616,760,065 and predicts the total cost at the end of the work of Rp. 157,383,943,827 and researchers also predicted project completion time of 381 days.

Keywords: Controlling, Planning, Cost Prediction, Time prediction, EVM, Schedule, Fireboat

1. INTRODUCTION

Companies located in Surabaya, which are mainly engaged in the production of commercial vessels, providing ship repair and maintenance services as well as general engineering with order-based specifications often experiencing problems of delays and cost overruns because of lack of supervision (Silvianita, 2018). Along with the development of the technology industry, ship production requires every shipyard to evaluate the system used. The new ship construction project is required to work fast according to the schedule. Poor performance, low quality, and cost overruns often occur in a project (Arica Dwi Susanto A. A., 2018).

The literature used in this paper were obtained to support the research. These literature includes paper titled A fuzzy pert approach to evaluate plant construction project scheduling risk under uncertain resources capacity (R.Lin, 2009). Earned Value Management Systems: Challenges and Future Direction (Wilson, 2013). CPM, PERT and Project Management With Fuzzy Logic Technique and Implementation On A Business (Mazlum, 2015). Integration of Building Information Modeling and Critical Path Method Schedules to Simulate the Impact of

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By using an Earned Value Method (EVM) calculation, it can predict the completion time and the remaining cost of 60 Meter ship construction, finding deviations between plans and reality, and encouraging them to look for the causes. This Paper is organized as follows. Section 2 review about the basic ship theory. Section 3 gives result and section 4 discussion of research. Finally, in section 5 present conclusion this paper.

2. MATERIALS AND METHODS

A. Technical Concept

The indicators used in the concept of the yield value or earned value method are(Ibrahim, 1993):

1. Actual cost (AC) or Actual Cost of Work Performed (ACWP)
   Is the actual cost of work that has been carried out at a certain reporting period. This fee is obtained from the accounting or financial data of the project at the reporting date (for example, the end of the month), which is a record of all actual expenditure expenses from workload or accounting codes including overhead calculations and others.
2. Earned value (EV) or Budgeted Cost of Work Performed (BCWP)
   Is the result value from the point of view of the work value that has been completed on the budget provided to carry out the work. If the AC number is compared to EV, you will see a comparison between the costs incurred for the work carried out on the Costs that should have been incurred.

   EV = Physical progress weight x Plan budget

   - Cumulative physical progress weight for all work, which is obtained from monthly progress reports
   - The plan budget is obtained by the contract RAB

3. Planned Value (PV) or Budgeted Cost of Work Scheduled (BCWS)
   Is the budget value for a workload that is integrated with the implementation schedule. There's combination of costs, schedules and scope of work, where each element of the work has been given a cost and schedule allocation that can be a benchmark for reporting the implementation of work.

   PV = Plan weight x Plan budget.

   - Cumulative physical progress weight for all work, which is obtained from time schedule
   - The plan budget is obtained by the contract RAB

Based on (Czarnigowska A., 2008), Variance is obtained from 3 indicators, which are:

a. Cost Variance (CV)

Cost variance is the difference between the value obtained after completing workload with actual costs incurred during project implementation.

CV=EV–AC or CV=BCWP–ACWP

- Negative (-): Cost Overrun
- Zero (0): Accordance with the cost plan
- Positive(+): Cost Underrun

b. Schedule Variance (SV)

The schedule variance is used to calculate deviations between BCWS and BCWP.

SV=BCWP– BCWS

- Negative (-): Longer than the time schedule
- Zero (0): Accordance with the time schedule
- Positive (+): Faster than the time schedule

Table. 1 Integrated Variance Analysis

SCHEDULE VARIANCE SV=BCWP-BCWS	COST VARIANCE CV=BCWP-ACWP	NOTES
Positive	Positive	Work is carried out faster than the schedule with more costs than the budget
Zero	Positive	Work is carried out right on schedule with lower costs than the budget
Positive	Zero	Work is carried out according to the budget and completed faster than the schedule
Zero	Zero	Work is carried out according to schedule and budget
Negative	Negative	Work is finished late and costs more than the budget
Zero	Negative	Work is carried out on schedule with costs above the budget
Negative	Zero	Work is finished late and costs according to the budget
Positive	Negative	The work is completed faster than the plan with costs above the budget

Some terms related to this assessment are Cost Performance Index, Schedule Performance Index, Estimate at Completion dan Variance at Completion (Indraga, 2015).

a. Cost Performance Index (CPI)

The cost efficiency factors that have been spent can be shown by comparing the value of physically completed work (BCWP) with costs that have been incurred in the same period (ACWP).

CPI = EV : AC or CPI = BCWP : ACWP

- CPI = 1 means that the project cost is in accordance with the plan
- CPI > 1 means that the project cost is less than the plan
- CPI < 1 means that the project cost is more than the plan

b. Schedule Performance Index (SPI)

Performance efficiency factors in completing work can be shown by a comparison between the value of physically completed work (BCWP) and the planned expenditure issued based on the work plan (BCWS).

SPI = EV : PV or SPI = BCWP : BCWS

- SPI = 1 means that the project time is in accordance with the plan
- SPI > 1 means that the project time is faster than plan
- SPI < 1 means that the project time is lower than the plan

c. Estimate at Completion (EAC)
CPI and SPI are to predict the statistical costs needed to complete the project.

EAC = ACWP + ((BAC – BCWP) / (CPI x SPI))

From the EAC value, an estimate of the difference between the cost of the project completion plan (BAC) and the cost of completion of the project is based on achieved work performance (EAC) or variance at completion (VAC).

VAC = BAC – EAC

B. Time prediction and Project Completion Cost

Cost estimates or project completion schedules based on indicators obtained when reporting will provide clues to the cost at the end of the project (Estimate At Completion = EAC) and project completion time estimation (Estimate All Schedule = EAS) (Naderpour, 2011). Cost or schedule forecasts are useful because they provide early warning about things that will occur in the future, if the trends that exist at the time of reporting have not changed. If the remaining work is considered to be a fixed performance as at the time of reporting, the estimated cost for the remaining work (ETC) is (Heizer, 2009):

ETC = (BAC - BCWP) : CPI
EAC = ACWP - ETC

Meanwhile, the estimate time of the completion of the works:

ETS = (remaining time) : SPI
EAS = Completion time + ETS

C. Method of Research.

In the analysis of this research, these following steps will be carried out: Schedule Variance (SV), Cost Variance (CV), Cost Performance Index (CPI), Schedule Performance Index (SPI) and Estimate At Completion (EAC).

3. RESULT

After processing the data, they were subsequently analyzed the data that has been processed. This data analysis was conducted to find out which activities have increased costs due to shortening of time seen from the critical path, so that the direct costs calculated are labor salaries (overtime).

Table. 2 Schedule and Duration of the Fireboat Construction Project

No	Activity	Duration (Day)	Start	Finish
	Hull Construction		10/10/2016	06/06/2017
1	Hull Fabrication	70	10/10/2016	15/01/2017
2	Hull Sub Assembly	104	18/10/2016	11/03/2017
3	Hull Assembly	137	26/10/2016	06/05/2017
4	Hull Erection	137	25/11/2016	06/06/2017
	Painting anode Catodic Protection		01/10/2016	22/05/2017
5	Blasting and Painting Raw Material	48	10/10/2016	15/12/2016
6	Block Blasting and Painting	137	15/11/2016	31/05/2017
7	Finishing Hull	27	06/06/2017	12/07/2017

No	Activity	Duration (Day)	Start	Finish
8	Painting Outfitting	79	06/06/2017	22/09/2017
9	Anode	19	14/03/2017	07/04/2017
	Hull Outfitting		10/10/2016	05/10/2017
10	Seat and Foundation	86	10/10/2016	07/02/2017
11	Deck Machinery and Equipment	86	07/02/2017	07/06/2017
12	Interior	171	07/02/2017	05/10/2017
	Machinery Outfitting		10/10/2016	05/10/2017
13	Piping System Including Ducting	181	10/10/2016	20/06/2017
14	Shafting	51	20/06/2017	30/08/2017
15	Machinery Outfitting	25	31/08/2017	05/10/2017
	Electric, Electronic Outfitting		10/10/2016	05/10/2017
16	Cabling	172	10/10/2016	07/06/2017
17	Power Supply	172	02/11/2016	01/07/2017
18	Illuminiation	172	26/11/2016	26/07/2017
19	Communication and Instrumentation	178	21/12/2016	18/08/2017
20	Computing and Information	172	13/01/2017	12/09/2017
21	Nautical and Radio	172	07/02/2017	05/10/2017
	Function and Commisioning		05/10/2017	30/10/2017
22	Machinery Commisioning	9	05/10/2017	18/10/2017
23	Equipment Commisioning	8	10/10/2017	21/10/2017
24	Lighting Commisioning	4	18/10/2017	24/10/2017
25	System Control Commisioning	4	24/10/2017	30/10/2017
	HAT and SAT		02/11/2017	18/12/2017
26	Harbour Acceptance Test	31	02/11/2017	16/12/2017
27	Yard Trial	14	27/11/2017	18/12/2017
	Delivery		20/12/2017	20/12/2017
28	Delivery to Customer	0	20/12/2017	20/12/2017

Table. 3 Project Budget Plan for Fireboat Construction

No.	Job Description		Cost (Rupiah)
A	**Hull Construction**		
	1	Hull Fabrication	Rp 46.176.942
	2	Hull Sub Assembly	Rp 6.244.996
	3	Hull Assembly	Rp 8.286.629
	4	Hull Erection	Rp 8.286.629
B	**Painting anode Catodic Protection**		
	5	Blasting and Painting Raw Material	Rp 3.242.594
	6	Block Blasting and Painting	Rp 2.522.018
	7	Finishing Hull	Rp 1.621.297
	8	Painting Outfitting	Rp 4.743.795
	9	Anode	Rp 1.140.913
C	**Hull Outfitting**		
	10	Seat and Foundation	Rp 5.224.179
	11	Deck Machinery and Equipment	Rp 5.224.179
	12	Interior	Rp 10.388.311
D	**Machinery Outfitting**		
	13	Piping System Including Ducting	Rp 10.928.743
	14	Shafting	Rp 3.122.498
	15	Machinery Outfitting	Rp 1.561.249

No.	Job Description		Cost (Rupiah)
E	**Electric, Electronic Outfitting**		
	16	Cabling	Rp 4.203.363
	17	Power Supply	Rp 4.563.651
	18	Illuminiation	Rp 4.383.507
	19	Communication and Instrumentation	Rp 4.743.795
	20	Computing and Information	Rp 4.803.843
	21	Nautical and Radio	Rp 3.963.171
E	**Function and Commisioning**		
	22	Machinery Commisioning	Rp 600.480
	23	Equipment Commisioning	Rp 540.432
	24	Lighting Commisioning	Rp 120.096
	25	System Control Commisioning	Rp 420.336
F	**HAT and SAT**		
	26	Harbour Acceptance Test	Rp 1.921.537
	27	Yard Trial	Rp 900.721
G	**Delivery**		
	28	Delivery to Customer	Rp 120.096
	TOTAL		Rp 150.000.000

A. Gantt Chart Planning for The Fireboat Construction Project

The planning schedule making for a fireboat construction project used Gantt Chart to determine when the activities were started, postponed, and completed.

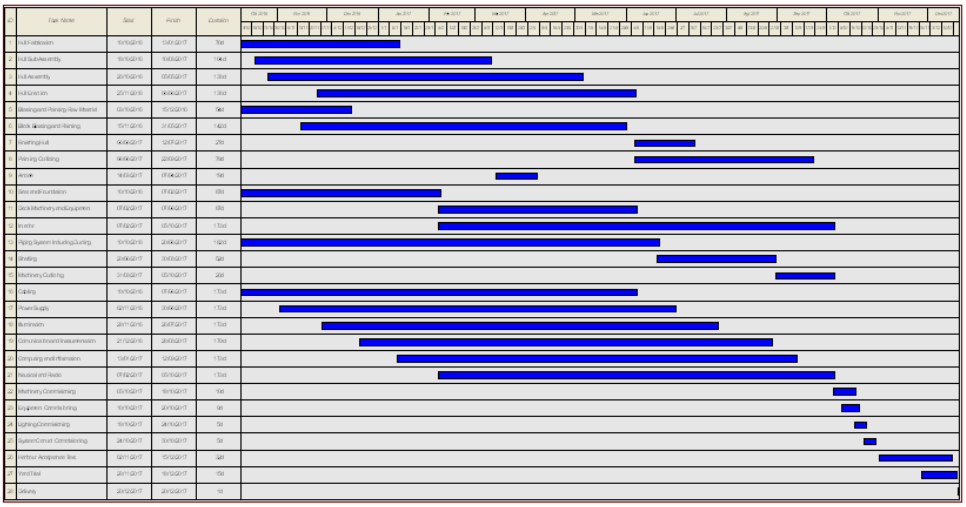

Fig. 1 Gantt Chart Planning for The Fireboat Construction Project

4. DISCUSSION

The calculation of the Earned Value Method (EVM) on this project resulted onBudget Cost Work Schedule (BCWS), Budget Cost Work Performed (BCWP), Actual Cost Work Performed (ACWP), Analysis of Cost Variances and Schedule Variances, Productivity and Performance Index.

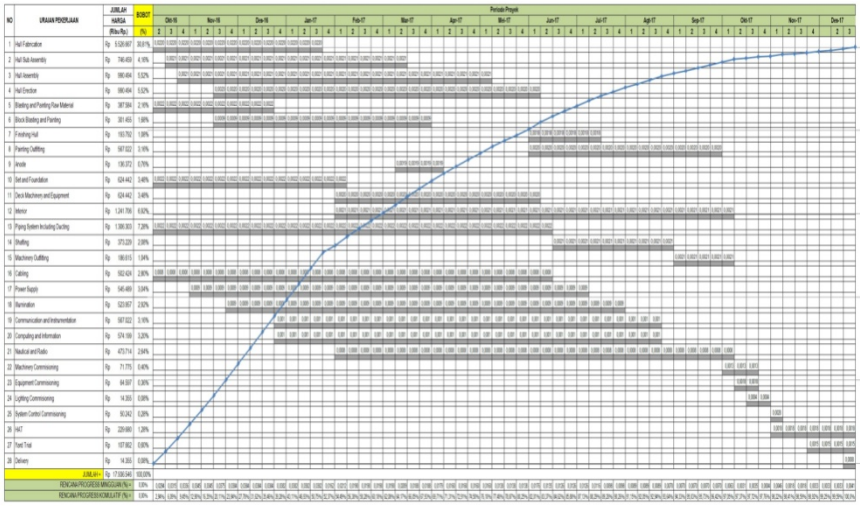

Fig. 2 S-Curve

Based on the S-curve depiction, it can be seen that the completion of the project was completed on day 314. Because this project is currently running, the project reporting period is made, where at the end of the period the work progress is submitted to the Contractor as presented in the following table:

Table. 4 Project Planning Period Date

Period	Day	Period Date	Plan Weight
1	16	10 Oct 16 – 31Oct 16	9,45%
2	38	1 Nov 16 – 30 Nov 16	14,50%
3	60	1 Dec 16 – 31 Dec 16	15,34%
4	82	1 Jan 16 – 31 Jan 17	13,09%
5	102	1 Feb 17 – 28 Feb 17	7,81%
6	125	1 Mar 17 – 31 Mar 17	7,75%
7	145	1 Apr 17 – 30 Apr 17	6,58%
8	168	1 May 17 – 31 May 17	5,75%
9	190	1 Jun 17 – 30 Jun 17	5,62%
10	211	1 Jul 17 – 31 Jul 17	4,38%
11	234	1 Agust 17 – 31 Agust 17	3,38%
12	255	1 Sep 17 – 30 Sep 17	2,78%
13	277	1 Oct 17 – 31 Oct 17	1,34%
14	299	1 Nov 14 – 31 Nov 17	1,16%
15	314	1 Dec 17 – 20 Dec 17	1,08%

Table. 5 BCWS Recapitulation

Period	Plan Weight	BCWS	BCWS Cumulative
1	9,45%	Rp14.166.232.836	Rp 14.166.232.836
2	14,50%	Rp21.734.606.133	Rp 35.900.838.970
3	15,34%	Rp23.001.259.607	Rp 58.902.098.577
4	13,09%	Rp19.625.219.490	Rp 78.527.318.067
5	7,81%	Rp11.719.419.104	Rp 90.246.737.171
6	7,75%	Rp11.624.092.843	Rp101.870.830.014
7	6,58%	Rp 9.868.688.520	Rp111.739.518.534
8	5,75%	Rp 8.627.310.802	Rp120.366.829.337
9	5,62%	Rp 8.440.159.436	Rp128.806.988.773
10	4,38%	Rp 6.578.035.155	Rp135.385.023.928
11	3,38%	Rp 5.069.612.508	Rp140.454.636.436
12	2,78%	Rp 4.174.521.435	Rp144.629.157.872

Period	Plan Weight	BCWS	BCWS Cumulative
13	1,34%	Rp 2.008.151.976	Rp146.637.309.848
14	1,16%	Rp 1.743.537.687	Rp148.380.847.535
15	1,08%	Rp 1.619.152.465	Rp150.000.000.000

Table. 6 BCWP Recapitulation

Period	Realization	Cumulative Realization	BCWP	Cumulative BCWP
1	7,98%	7,98%	Rp 11.970.466.747	Rp 11.970.466.747
2	12,86%	20,84%	Rp 19.278.595.640	Rp 31.249.062.387
3	13,15%	33,99%	Rp 19.712.079.484	Rp 50.961.141.870
4	11,80%	45,79%	Rp 17.701.947.980	Rp 68.663.089.850
5	7,02%	52,81%	Rp 10.535.757.775	Rp 79.198.847.625
6	6,11%	58,92%	Rp 9.171.409.253	Rp 88.370.256.878
7	5,84%	64,76%	Rp 8.763.395.406	Rp 97.133.652.284
8	4,39%	69,16%	Rp 6.591.265.453	Rp 103.724.917.737
9	4,46%	73,62%	Rp 6.693.046.433	Rp 110.417.964.170
10	3,20%	76,82%	Rp 4.808.543.699	Rp 115.226.507.869
11	2,93%	79,75%	Rp 4.395.354.045	Rp 119.621.861.913
12	2,54%	82,29%	Rp 3.815.512.592	Rp 123.437.374.505
13	1,25%	83,55%	Rp 1.879.630.250	Rp 125.317.004.755
14	1,02%	84,57%	Rp 1.532.569.627	Rp 126.849.574.382
15	0,79%	85,36%	Rp 1.186.838.757	Rp 128.036.413.139
16	7,40%	92,76%	Rp 11.100.000.000	Rp 139.136.413.139
17	3,10%	95,86%	Rp 4.650.000.000	Rp 143.786.413.139
18	4,14%	100,00%	Rp 6.210.000.000	Rp 150.000.000.000

Table. 7 ACWP Recapitulation

Period	ACWP	ACWP Cumulative
1	Rp 12.568.990.084	Rp 12.568.990.084
2	Rp 20.049.739.466	Rp 32.618.729.550
3	Rp 20.303.441.868	Rp 52.922.171.418
4	Rp 18.055.986.939	Rp 70.978.158.357
5	Rp 10.641.115.353	Rp 81.619.273.710
6	Rp 10.363.692.456	Rp 91.982.966.166
7	Rp 9.376.833.084	Rp 101.359.799.250
8	Rp 6.723.090.762	Rp 108.082.890.012
9	Rp 6.893.837.826	Rp 114.976.727.838
10	Rp 5.193.227.194	Rp 120.169.955.033
11	Rp 4.746.982.368	Rp 124.916.937.401
12	Rp 4.082.598.473	Rp 128.999.535.874
13	Rp 1.917.222.855	Rp 130.916.758.729
14	Rp 1.639.849.501	Rp 132.556.608.230
15	Rp 1.210.575.532	Rp 133.767.183.762

Table. 8 Cost Variance and Schedule Variance calculations

Period	Cost Variance	Schedule Variance
1	-Rp 598.523.337	-Rp2.195.766.090
2	-Rp 771.143.826	-Rp2.456.010.493
3	-Rp 591.362.385	-Rp3.289.180.124
4	-Rp 354.038.960	-Rp1.923.271.510
5	-Rp 105.357.578	-Rp1.183.661.330

Period	Cost Variance	Schedule Variance
6	-Rp1.192.283.203	-Rp2.452.683.590
7	-Rp 613.437.678	-Rp1.105.293.114
8	-Rp 131.825.309	-Rp2.036.045.349
9	-Rp 200.791.393	-Rp1.747.113.003
10	-Rp 384.683.496	-Rp1.769.491.457
11	-Rp 351.628.324	-Rp 674.258.464
12	-Rp 267.085.881	-Rp 359.008.843
13	-Rp 37.592.605	-Rp 128.521.726
14	-Rp 107.279.874	-Rp 210.968.060
15	-Rp 23.736.775	-Rp 432.313.708

Table. 9 Value of Project Performance in CPI and SPI

Period	CPI	SPI	Notes
1	0,95	0,85	Cost overrun &Schedule underrun
2	0,96	0,87	Cost overrun &Schedule underrun
3	0,96	0,87	Cost overrun &Schedule underrun
4	0,97	0,87	Cost overrun &Schedule underrun
5	0,97	0,88	Cost overrun &Schedule underrun
6	0,96	0,87	Cost overrun &Schedule underrun
7	0,96	0,87	Cost overrun &Schedule underrun
8	0,96	0,86	Cost overrun &Schedule underrun
9	0,96	0,86	Cost overrun &Schedule underrun
10	0,96	0,85	Cost overrun &Schedule underrun
11	0,96	0,85	Cost overrun &Schedule underrun
12	0,96	0,85	Cost overrun &Schedule underrun
13	0,96	0,85	Cost overrun &Schedule underrun
14	0,96	0,85	Cost overrun &Schedule underrun
15	0,96	0,85	Cost overrun &Schedule underrun
16	0,94	0,93	Cost overrun &Schedule underrun
17	0,94	0,96	Cost overrun &Schedule underrun
18	0,93	1,00	Cost overrun &Schedule underrun

A. Estimation of Project End Time and Costs

Estimation of the final time and costs of project completion can be done using indicators obtained at the time of reporting to provide a final project estimation. This estimation is useful in providing early warnings about things that will happen in the future, based on the assumption that the trends that exist and are revealed at the time the reporting has not changed. It is also useful to provide a forward-looking picture to the Contractor, so that it can take the necessary corrective steps.

1. ETC (Estimate to Completion):
Estimated costs for the remaining work, assuming that the trend of project performance will remain constant until the end of the project, obtained by:
ETC = (Project Total Anggaran Total Proyek - BCWP): CPI
ETC = (Rp. 150.000.000.000 - Rp. 128.036.413.139) : 0,93
ETC = Rp 23.616.760.065

2. EAC (Estimate at Completion): Estimated total cost at the end of the project, obtained by:
EAC = ACWP + ETC
EAC = Rp. 133.767.183.762 + Rp. 23.616.760.065
EAC = Rp. 157.383.943.827

3. ECD (Estimated Completion Date): Estimation of Project Completion Schedule.
   ECD = (Remaining Time : SPI) + time spent
   ECD = (57 : 0,85) + 314
   ECD = 381 days

5. CONCLUSION

Based on the results of the analysis that has been done by researchers that the calculation of ongoing activities of the fireboat project should be based on planning takes 314 days, because there is a delay in work the researchers estimate the addition of time to the completion of the project 67 days so the time needed for the fireboat project to finish is 381 days . With the addition of time, the cost to complete the work will increase Rp. 23,616,760,065, and the total cost at the end of the work is Rp. 157,383,943,827.

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Evaluation of Growth and Yield of Genetically Modified Wheat (Triticum sp.) Seed and Farmer Sourced Unmodified Seed Under Mechanized and Traditional Methods of Land Preparation

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Abstract
Mechanized cultivation produced slightly higher crop yields (average 7.97 metric tonnes/hectare) than traditional cultivation (average 7.65 metric tonnes/hectare). However this difference was not statistically significant. A confounding factor may have been the fact that the mechanized treatments had less fertilizer applied than the traditional treatments. Approximately 20% less fertilizer was used on the trial plots that were cultivated by the mechanized method. The seed sowing rate on the mechanized plots was also lower (125kg/ hectare) compared with the traditional plots (150-175kg/hectare). There was very little difference in yield between the farmer sourced seed genetics and the Private Seed Company Enterprise (PSE) sourced certified seed genetics, where both lines of seed had been cleaned and dressed by the PSE. Both these lines of seed produced very high yields (averages 8.9 and 8.5 tonnes/hectare respectively).The significant finding from this trial was the large difference in yield between the seed that was cleaned and dressed by the PSE (average yield 8.6 metric tonnes/hectare) and the crops produced from unprocessed farmer seed (average yield 6.23 tonnes/hectare). This difference was highly statistically significant (P>0.99).[1]

Keywords: Mechanized Cultivation, Private Seed Company Enterprise, Wheat, Traditional Cultivation, Thyram Fungicide

Introduction

In Afghanistan, wheat occupies around 70% of the total cropped area (rain-fed and irrigated) and comprises 70% of the country's total cereal production (Hampton, 2013). However, mean yields are low, ranging from 0.35mt/ha

[1] Paired t-test

(local variety, no fertiliser, rain-fed) to 2.9mt/ha (improved variety, fertiliser, irrigation). In Bamyan, low yields occur because:

(i) the land is usually mono-cropped (i.e. wheat after wheat after wheat);
(ii) access to improved varieties and quality seed is limited;
(iii) access to fertiliser, herbicides and pesticides is limited;
(iv) very few farmers have access to machinery for cultivation/harvesting; and
(v) the rural infrastructure has been damaged.

Overcoming all of these constraints will require significant resources and time, but within the present production environment some initial change is possible and can be achieved by demonstrating to farmers the yield benefits accruing from the use of certified (i.e. quality) seed, mechanised seed bed preparation, chemical fertilisers and irrigation. This was the purpose of the winter wheat demonstration plot in the Waras District of Bamyan Province.

The aims of this study were: (1) to confirm the effect of mechanization and traditional methods of land preparation under high and low soil biological activity on growth and yield of wheat, (2) to evaluate the yield components of traditional Private Seed Company Enterprise (PSE) certified sourced seed and traditional farmer sourced seed in response to different fertilizers application rates, and (3) to evaluate the yield components of mechanized and traditional farmer sourced seed in response to different fertilizers application rates.

Materials and Methods

Land Preparation

The land used belonged to one of the co-operative members in Waras district of Bamyan Province. The soil type was a silty clay loam. Half of the land (comprising Site B1, B2 and C1) (Mechanised Cultivation) was prepared mechanically by tractor using a two-bladed mouldboard plough and nine tine harrow. The other half of the land (comprising Sites A1, A2 and C2) (Traditional Cultivation) was prepared by a local farmer who used a bullock and wooden plough.

Three types of seed were planted on each half of the trial area:

- Certified seed from the PSE (variety Solh-2002) (Sites A2 and B1);
- Farmer bred seed that was cleaned and dressed by the PSE (Sites A1 and B2); and
- Farmer bred seed that was unprocessed (Sites C1 and C2).

Farm Yard Manure (FYM) and Ash Application

Seven and half tonnes of farm yard manure (sheep manure) (FYM), including 1.5 tonnes of wood ash, was applied to site B, Site A and Site C on 10 October 2012, 20 days ahead of cultivation. Potassium (K) deficiency is common in Afghanistan calcareous soils. About 90-98% of K is bound to mica and feldspar clay minerals for example, potassium aluminium silicate ($KAlSi_3O_5$) and is unavailable for plants to be taken up. This means that only less than 1% of exchangeable K^+ is available in soil solution (Hashami, 2011). Farmers are unable to purchase this important soil nutrient in Afghanistan, because of its possible use in bomb making, the only option was to use wood ash to overcome some of the potassium deficiency in the soil. The land was irrigated before FYM application and sowing in order to let the FYM to fully penetrate the soil.

Sowing Rate and Cultivation Method

The sowing rates for site B, A, and C respectively were 25, 30 and 35 kg/jerib. These rates equate to approximately 125, 150 and 175 kg/hectare respectively. The seed was treated with Thyram fungicide prior to sowing.

Irrigation and Fertiliser Application

For Site B, the Float Method (Q= A x V) where Q is the volume of water in cubic meter per second, V is velocity of water in meter per second and A is the water follow section was used then the total time to irrigate Site B was recorded and the total volume of water applied determined. The volume of water applied to Site A was not recorded but rather left to the discretion of the farmer, which is common practice in Bamyan. All the three sites were irrigated 6 times before harvesting using the float method of measuring water (refer Appendix II). The application of water 6 times was less than typical Bamyan farmer would do, which is usually 8 to 10 times.

Two kinds of chemical fertilisers, nitrogen in the form of Urea and phosphorus in the form of DAP were applied to all the three Sites. For Site B, urea was applied at the rate of 205kg N/ha and for Sites A and C 250 kg N/ha. For Site B, DAP was applied at the rate of 105 kg P/ha and for Sites A and C 125 kg P/ha. All the DAP fertiliser was applied during the cultivation and sowing and urea fertiliser was divided into three parts and applied on three separate occasions.

The first portion was applied when the germination percentage reached 100 %, the second portion was applied during the tillering stage and finally, the third portion was applied during the early ear emergence.

After each urea application the trial was irrigated in order to reduce the urea volatilization into the atmosphere.

Observations Recorded before Harvesting

Two separate observations were recorded throughout the trial; germination and plant height. When the first observation was taken on 19 March 2013, the germination percentage was 3% and a final germination percentage of 100% was recorded on 4 April 2013 (refer Figure 1). For Site B the average plant height was 63.7 cm, for Site A and C the average plant height was 57 cm and 53.5 cm respectively.

Figure 1: Study Trial when the germination reached 100%.

Harvesting Method

The trial was harvested on 16 August 2013. Using a 1 meter square (quadrat), within each plot three randomly samples were taken and the average yield recorded. Maximum effort was undertaken to make sure that no single seed remained attached to the ear and a standard balance was used for weighing the wheat samples harvested from each plot. Figures 2 and 3 below show the wheat being sampled by using 1 meter quadrat and how the wheat was collected from the ground and waiting for the threshing.

Figure 2. Using 1 meter quadrat for taking the wheat samples.

Figure 3: Collected wheat waiting for the threshing.

Results

Yield results from the various plots are shown below in Table 1.

Table 1: Waras Winter Wheat Trial Yield Results

Treamtments	AverageYield (kg)/m^2	Average Yield (kg)/jerib	Average Yield (MT/jerib)	Average Yield (MT/ha)
B1- Mechanized PSEs	1.10	1800	1.80	9.00
B2-Mechanized Farmer seed	1.11	1780	1.78	8.90
A1-Traditional Farmer seed	1.10	1700	1.70	8.50
A2-Traditional PSEs	1.07	1600	1.60	8.00
C1-Mechanized farmer unprocessed seed	0.74	1200	1.20	6.00
C2- Tradtional farmer unprocessed seed	0.65	1290.24	1.29	6.45

A statistical analysis was also undertaken comparing processed seed with unprocessed seed, PSE seed genetics with farmer seed genetics and mechanized cultivation with traditional cultivation. The results of this analysis are summarized below.

Mechanized cultivation produced slightly higher crop yields (average 7.97 metric tonnes/hectare) than traditional cultivation (average 7.65 metric tonnes/hectare). However this difference was not statistically significant. A confounding factor may have been the fact that the mechanized treatments had less fertilizer applied than the traditional treatments. Approximately 20% less fertilizer was used on the trial plots that were cultivated by the mechanised method. The seed sowing rate on the mechanized plots was also lower (125kg/ hectare) compared with the traditional plots (150-175kg/hectare).

There was very little difference in yield between the farmer sourced seed genetics and the PSE sourced certified seed genetics, where both lines of seed had been cleaned and dressed by the PSE. Both these lines of seed produced very high yields (averages 8.9 and 8.5 tonnes/hectare respectively).

The significant finding from this trial was the large difference in yield between the seed that was cleaned and dressed by the PSE (average yield 8.6 metric tonnes/hectare) and the crops produced from unprocessed farmer seed (average yield 6.23 tonnes/hectare). This difference was highly statistically significant ($P>0.99$)[2].

Discussion and Conclusions

The wheat yields obtained from the processed seed lines in this trial are similar to those obtained internationally from higher yielding wheat crops.
For example, UK producers, who have the highest wheat yields in the world, had average production of 7.7 tonnes per hectare in 2011. By comparison the national average in Pakistan was 2.6 tonnes/hectare.[3]

This shows that there is potential to produce similar yields to those of the UK using locally available seed. These yields are more than 400% higher than current average production by Bamyan farmers.
However, in order to produce these high yields:

1. The seed must be correctly cleaned, dressed and stored; and
2. Correct husbandry guidelines must be followed.

Evaluation of the use of mechanised cultivation in this trial was confounded by the use of different fertiliser rates for mechanised and non-mechanized treatments.

[2] Paired t-test
[3] http://www.thenews.com.pk/Todays-News-3-99616-Pakistan-lags-behind-in-per-hectare-crop-yield

The treatments where the traditional cultivation method was used had higher fertiliser rates applied, similar to those currently in use by farmers in the area. By comparison, the fertiliser rates for the mechanised treatments were calculated based on a scientific assessment of crop demand, the soil profile and recommendations from DAIL and FAO. These rates were lower. The fact that the mechanized treatments using PSE processed seed produced similar crop yields to the traditional treatments, but with lower fertiliser rates, suggests that the value of mechanised cultivation was in reducing fertiliser costs whilst obtaining high crop productivity. Fewer weeds were observed in the mechanised treatments compared with traditional cultivation, suggesting another key benefit of mechanised cultivation is reducing crop completion from weeds. The trial also suggested that the DAP fertiliser should be applied all at sowing and the urea fertilizer should be applied in three separate occasions.

Other good husbandry practices used to obtain these yields were:

- Seed treatment with fungicide prior to planting
- Regular crop inspections
- Controlled application of water according to crop requirements
- Regular hand weeding
- Removal of off-types and defective wheat plants before harvest

Recommendations

The results of this trial support the following recommendations:

1. Wheat seed should be processed cleaned and properly stored ahead of cultivation.
2. Treat the wheat seed with fungicide (Thyram) before planting in order to control or decrease the smut disease which is common in Bamyan winter wheat fields.
3. The correct use of mechanised cultivation will improve wheat productivity. Deeper ploughing of land, which can only be obtained using a tractor and mouldboard plough, allows the wheat root to penetrate deeper into the ground and develop more. Another benefit of mechanised cultivation is to reduce weeds in the crop.
4. Measured application of farmyard manure (FYM) and chemical fertilizers will also increase yields. It is recommended to apply all of the DAP fertilizer at sowing and urea in three separate applications instead of applying it only once.
5. Apply the FYM at least 20 days ahead of cultivation in order to let the manure get the maximum fixation within the soil.
6. The ratio of DAP and urea fertilisers should be correctly calculated.
7. The three separate urea applications should be done at sowing, tillering stage and early ear emergence.
8. After applying urea irrigate the land to reduce losses from volatilisation.

It is important to measure the timing and amount of water going to the field and irrigate the field more, but we recommend light irrigation over heavy watering (i.e. apply water more frequently but less heavily).

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