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ORIGINAL RESEARCH

ANALYSIS OF LEVEL TEAM EFFECTIVENESS IN THE IMPLEMENTATION OF SCRUM USING EVIDENCE-BASED MANAGEMENT (CASE STUDY: COMPANY A AS A FINTECH INDUSTRY)

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Abstract

In implementing Scrum in Company A, which is a fintech company, there is a Scrum Master who is responsible for ensuring the effectiveness of the Scrum team. The Scrum Master of Company A still uses the velocity chart to measure team effectiveness. Still, the use of the velocity chart itself cannot describe the level of responsiveness of the team in delivering products to users. In this study, the application of EBM is used as a metric to replace the velocity chart in analyzing the level of effectiveness of the Scrum team in Company A. Through FGDs with senior Scrum Masters. The EBM metric was selected to be used in the analysis. The application of EBM is carried out by collecting primary data from each team and secondary data from company data. Data from each team was analyzed and weighted. The results of this study indicate the effectiveness score of each team. Based on these scores, the Scrum Master can determine which team's process needs to be improved. This research can be used as an illustration for companies that implement Scrum in measuring the effectiveness of Scrum teams.

KEYWORDS:

Agile, Evidence-Based Management, Fintech, Scrum, Team Effectiveness

1 | INTRODUCTION

Scrum is an agile framework for product development processes that often experience changes caused by unpredictable factors[1, 2]. Scrum itself is widely favored in the development of software products compared to other Agile methods, which is 87%[3]. The corporate sector using the Scrum framework varies, such as marketing, e-commerce, financial technology, HRIS, etc.[4]. Company A is engaged in the financial technology sector and applies Scrum in its software development. At company

A, there is a team of Scrum Masters who are responsible for improvising the product development process[5]. This aligns with the Scrum master's responsibilities according to the Scrum Guidelines to ensure team effectiveness. Measuring the effectiveness of the team can help the Scrum master to inspect the problems faced by the team. The evidence in the team must guide the inspection carried out. So, with the available evidence, processes can be improvised so the team can work more effectively. At company A, no metric is used to measure team effectiveness. Therefore, this research applies Evidence-Based Management (EBM) as a metric to measure the effectiveness of the Scrum team in company A.

Evidence-Based Management (EBM) is an empirical approach to finding out and measuring the team's current condition by using real evidence in the field[6, 7]. Evidence-Based Management is a method derived from evidence-based medicine often used in the medical field. Evidence-Based Medicine is a decision-making step in the clinical field based on the wise, thorough, and explicit use of scientific evidence integrated with the doctor's clinical abilities and patient preferences[8]. Evidence-Based Medicine is used in the clinical world because there is information related to the health sector that is continuously developing. More is needed to be based on theoretical foundations in books. Therefore, based on the similarity of product development conditions in information technology which are also flexible and always evolving, the Scrum organization presents an evidence-based measurement tool in information technology management called Evidence-Based Management. This tool assists the management team in making decisions to improve the performance of the Scrum team[9]. In this study related to the implementation of EBM, the aim is to find out EBM metrics that can be applied to Company A and to analyze the level of effectiveness of the three Scrum teams in Company A. The three Scrum teams are the ARR team, REV team and FC team which are the three major teams in product development. Company A. The results of the analysis carried out are used as material for evaluation by the Scrum Master team at Company A to improvise processes for product development[10].

2 | PREVIOUS RESEARCHES

In this research, a literature study was carried out related to relevant theories through previous studies. According to research conducted by Kurnia et al.[11] regarding Scrum metrics, management must use metrics to make decisions in overcoming complex problems. Kurnia et al.[11] conducted a literature study to define several metrics widely used by several companies and have a high success rate in their application. These metrics include job satisfaction, EVM (Earned Value Management), customer satisfaction, value delivered, release burnup, sprint burndown, story points, and velocity. In the research conducted by Kurnia, the Scrum metrics described are more complete than the metrics applied by Company A. However, in measuring team effectiveness, the metrics provided still need to describe how often the team can release in one Sprint in accordance with the understanding of the research by Verwijs and Russo[12] related to Scrum team effectiveness[13].

Other research related to metrics was also carried out by Dixit and Bhushan[14] through a literature study to define possible metrics to be applied in the use of Scrum. These metrics are divided into four major categories: Measuring Deliverable, which consists of Sprint goal success, escaped defect and defect density, team velocity, and burndown chart. The second category is Measuring effectiveness which consists of time to market, return on investment, capital redeployment, and customer satisfaction. The next category is Monitoring the Scrum Team, which consists of daily Scrum, sprint retrospective, team satisfaction, team member turnover, and team productivity. The last category is Scrum Reporting for stakeholders, which consists of sprint burndown, release burndown, sprint velocity, scope change, team capacity, and escaped defects. Their research has addressed the shortcomings of research by Kurnia et al.[11].

Regarding Scrum metrics that can be used to measure team effectiveness. In addition, some metrics defined by Dixit and Bhushan[14] also has similarities with the EBM metrics defined by Scrum. So, EBM metrics can be used to measure the Scrum team. EBM adapts metrics in four key value areas, namely Current Value (revenue per employee, product cost ratio, employee satisfaction, customer satisfaction, customer usage index), Unrealized Value (market share, customer or user satisfaction gap, desired customer experience or satisfaction), Time to Market (build and integration frequency, release frequency, release stabilization period, mean time to repair, customer cycle time, lead time, lead time for a change, deployment frequency, time to restore service, time to learn, time to remove impediments) and Ability to innovate (innovation rate, defect trends, on product index, installed version index, technical debt, production incident count, active product code branches, the team spent merging Code between branches, time spent context switching, change failure)[15].

TABLE 1 The rating scale interpretation.

Scare	Description
0.1 - 1	Very unenthusiastic/very uninvolved
1.1 - 2	Not unenthusiastic/not uninvolved
2.1 - 3	Moderately enthusiastic/moderately involved
3.1 - 4	Enthusiastic/often involved
4.1 - 5	Very enthusiastic/very involved

3 | MATERIAL AND METHOD

The type of this research is analysis research, and the methods used are qualitative. There are two main steps within this study, i.e. metric selection and ..... This section presents the steps in more detail.

3.0.1 | Metric Selection

In EBM, there are 4 Key Value Areas[6], namely:

- Current Value: revenue per employee, product cost ratio, employee satisfaction, customer satisfaction, and customer usage index;
- Unrealized Value: market share, customer or user satisfaction gap, and desired customer experience or satisfaction;
- Time to Market: build an integration frequency, release frequency, release stabilization period, mean time to repair, customer cycle time, lead time, lead time for a change, deployment frequency, time to restore service, time to learn, and time to remove impediments;
- Ability to Innovate: innovation rate, defect trends, on-product index, installed version index, technical debt, production incident count, active product branches, time spent merging Code between branches, time spent context-switching, and change failure rate.

For each of the metrics contained in the four EBM categories, a selection of metric data will be carried out that can be applied in company A. Metric selection is carried out by conducting Focus Group Discussions with eight senior Scrum Masters to determine the product development process running in Company A. It is hoped that from the Focus Group Discussion, it will be known what metrics can be used to analyze the level of effectiveness of the Scrum team in Company A.

3.0.2 | Data Collection

After selecting the metrics to be used, data collection will then be carried out. Data was collected through unstructured interviews during retrospective events at each Sprint with each team member. Interviews were conducted to obtain primary data, which will be mapped to EBM metrics. The data relates to employee satisfaction, time to remove barriers, and time to switch contexts. In this study, there were three teams as samples. The sample was obtained by purposive sampling, consisting of people directly involved in the Scrum team with job specifications as Product Owner, Scrum Master, and Developer in Company A. The three teams that were sampled were the REV team, FC team, and ARR team. The REV team consists of 6 people, the FC team consists of 6 people, and the ARR team consists of 9 people. . Data collection was carried out for four months or eight sprint events (August-November 2022). In obtaining data on employee satisfaction, a rating scale is used from 1-5, where number 1 indicates the lowest level of enthusiasm and number 5 indicates the highest, as described in Table 1 .

Furthermore, to determine the time spent context-switching, it is necessary to explore related to the start date of context-switching and the date of ending of context-switching in a team in one Sprint. Similar to the time spent context switching, time to remove impediment was also mined in terms of the date the impediment was found and the date the impediment was resolved in a team in one Sprint.

TABLE 2 The EBM selection metrics.

Category	Metrics
Applicable Metrics	Employee Satisfaction, Release Frequency, Mean Time to Repair, Customer Cycle Time, Lead Time, Deployment Frequency, Time to Learn, Innovation Rate, Defect Trends, On-Product Index, Technical Debt, Production Incident Count, Time Spent Context-Switching, Time to Remove Impediment
Unenforceable Metrics	Customer Satisfaction, Customer Usage Index, Time to Remove Impediment, Installed Version Index, Desired Customer Experience or Satisfaction, Customer or User Satisfaction Gap, Revenue per Employee, Product Cost Ratio, Tine to Restore Service, Active Product (Code) Branches, Time Spent Merging Code Between Branches, Change Failure Rate, Market Share.

3.0.3 | Data Processing and Analysis

Data processing is required when the data has been collected. The data mapped into the EBM needs to be calculated to get each team's score over four months. Furthermore, to find out the final score in the form of the level of effectiveness of the Scrum team in the company based on all EBM components, the weighting is carried out using the Ranking Order Centroid (ROC) method[16, 17]. Eq. 1 is the formula for finding weights using the ROC method.

$$W_n = \frac{1}{k} \sum_{i=1}^{k} \frac{1}{i} \tag{1}$$

Where:
W_n = weighting value of the nth attributes
k = number of attributes
i = attribute priority order value

4 | RESULTS AND DISCUSSION

This section presents the result of each step of this study. The first sub-section presents the selection metrics. The second sub-section presents the quantitative result and its analysis.

4.1 | Selection Metrics

According to the selection metrics, EBM metrics are grouped into two categories, and the results of the FGD are shown in Table 2 .

1. **Applicable Metrics**: these are EBM metrics whose data can be obtained through internal company data, either in the form of databases or from research instrument documentation, which in the process of obtaining the data, will not change the current flow of product development in the Company A.

2. **Unenforceable Metrics**: metrics whose data cannot be obtained or used due to credential data, undocumented processes, and the need for additional licenses for several tools so that data can be obtained, which requires additional costs by the company.

4.2 | Data Processing and Analysis

Once the metrics used in Company A are known, the data is collected and mapped into EBM. However, the mapping results are still in the form of raw data from each individual in the team in each Sprint. Therefore, the data needs to be processed to get a value for each team in a certain period, which is for eight sprints. Here are some calculation formulas for each metric as follows.

4.2.1 | Employee Satisfaction

Eq. 2 is the formula for calculating employee satisfaction.

$$Average\ of\ employee\ satisfaction = \frac{\sum \frac{\sum_{n=0}^{n} k}{n}}{\sum \text{sprint}} \tag{2}$$

Where:
k = customer satisfaction data per individual in the team filled out using a rating scale (1-5).
n = the number of data.
sprint = number of sprints in one time period.

4.2.2 | Customer Usage Index

Eq. 3 is the formula for calculating the customer usage index.

$$Average\ of\ customer\ usage\ index = \frac{\sum active\ user}{\sum \text{registered user}} \tag{3}$$

Where:
active user = number of users who use the product actively
registered user = number of registered users
n = total product developed by the Scrum team

4.2.3 | Customer Cycle Time

Eq. 4 is the formula for calculating the customer usage index.

$$Average\ of\ cycle\ time = \frac{\sum NETWORKDAYS; \left(start\ date_{ticket}, solve\ date_{ticket}\right) \times frequency}{\sum \text{frequency}} \tag{4}$$

Where:
NETWORKDAYS = number of active working days (one week = 5 working days)
$start\ date_{ticket}$ = date the ticket enters the Sprint
$solve\ date_{ticket}$ = date the ticket was completed
frequency = total work against a time

4.2.4 | Lead Time

Eq. 5 is the formula for calculating lead time.

$$Average\ of\ lead\ time = \frac{\sum NETWORKDAYS; \left(created\ date_{ticket}, release\ date_{ticket}\right) \times frequency}{\sum \text{frequency}} \tag{5}$$

Where:
NETWORKDAYS = number of active working days (one week = 5 working days)
$created\ date_{ticket}$ = date the ticket was created
$release\ date_{ticket}$ = date the ticket was released
frequency = total work against a time

4.2.5 | Mean Time to Repair

Eq. 6 is the formula for calculating the mean time to repair.

$$Average\ of\ mean\ time\ to\ repair = \frac{\sum NETWORKDAYS; \left(created\ date_{bug}, release\ date_{bug}\right) \times frequency}{\sum \text{frequency}} \tag{6}$$

Where:
NETWORKDAYS = number of active working days (one week = 5 working days)
$created\ date_{ticket}$ = date the ticket was created
$release\ date_{ticket}$ = date the ticket was released
frequency = total work against a time

4.2.6 | Release and Deployment Frequency

Eq. 7 is the formula for calculating release and deployment frequency.

$$Number\ of\ release = \sum \text{fequency release} \tag{7}$$

Where:
frequency release = number of releases in a certain time-frame

4.2.7 | Innovation Rate/on Product Index

Eq. 8 is the formula for calculating innovation rate / on product index.

$$Average\ of\ product\ index = \frac{\sum user\ story}{\sum \text{user story} + \sum \text{spikey} + \sum \text{bug} + \sum \text{task} + \sum \text{subtask}} \tag{8}$$

Where:
user story = number of tickets with the user story type
spike = number of tickets with spike type
bug = number of tickets with bug type
task = number of tickets with task type

4.2.8 | Production Incident Count

Eq. 9 is the formula for calculating production incident count.

$$Production\ incident\ count = \sum \text{bug} \tag{9}$$

Where:
bug = number of bug tickets in one time period

4.2.9 | Time to Learn

Eq. 10 is the formula for calculating time to learn:

TABLE 3 The data processing.

EBM Metrics	Score Each Team		
	ARR	REV	FC
Employee Satisfaction (+)	3.9	4.67	2.92
Customer Usage Index (+)	3.3	34.85	0.0
Customer Cycle Time (-)	6.59	6.61	5.09
Lead Time (-)	68.83	13.6	17.4
Mean Time to Repair (-)	5	2	1
Release and Deployment Frequency (+)	2	10	2
Innovation Rate/ On Product Index (+)	24.21	35.51	50.75
Production Incident Count (-)	6	11	7
Time to Learn (+)	2	12	0
Technical Debt (-)	69	0	31
Time to Remove Impediment (-)	31.167	14.33	11
Time Spent Context-Switching (-)	2	0	4.3

$$Time\ to\ learn = \sum \text{spike} \tag{10}$$

Where:
spike = number of spike tickets in one time period

4.2.10 | Technical Debt

Eq. 11 is the formula for calculating technical debt.

$$Technical\ debt = minimum\ standard - \frac{\sum coverage\ code}{\sum all\ code} \times 100 \tag{11}$$

Where:
minimum standard = Company A's minimum standard regarding code coverage (80*coverage code* = the amount of Code that has been fulfilled through unit testing
all code = the total number of codes that must be fulfilled through unit testing

4.2.11 | Time to Remove Impediment

Eq. 12 is the formula for calculating the time to remove impediments.

$$Average\ of\ time\ to\ remove\ impediment = \frac{\sum NETWORKDAYS; \left(created\ date_{impediment}, solve\ date_{impediment}\right)}{\sum \text{impediment}} \tag{12}$$

Where:
NETWORKDAYS = number of active working days (one week = 5 working days)
created date impediment = date the impediment was found
solve date impediment = date the impediment was solved

4.2.12 | Time Spent Context-Switching

Eq. 13 is the formula for calculating time spent context-switching.

TABLE 4 The data ranking.

EBM Metrics	Score Each Team		
	ARR	REV	FC
Employee Satisfaction	2	1	3
Customer Usage Index	2	1	0
Customer Cycle Time	2	3	1
Lead Time	3	1	2
Mean Time to Repair	3	1	2
Release & Deployment Frequency	2	1	2
Innovation Rate/On-Product Index	3	2	1
Product Incident Count	1	3	2
Time to Learn	2	1	3
Technical Debt	3	2	1
Time to Remove Impediment	3	2	1
Time to Context-Switching	2	1	3

TABLE 5 The criteria weight priority.

Criteria Priority Order	Criteria Weight Priority
K1	$W_1 = \frac{1}{3}x(\frac{1}{1} + \frac{1}{2} + \frac{1}{3}) = 0.61$
K2	$W_2 = \frac{1}{3}x(0 + \frac{1}{2} + \frac{1}{3}) = 0.28$
K3	$W_3 = \frac{1}{3}x(0 + 0 + \frac{1}{3}) = 0.11$

$$Average\ of\ time\ to\ context\ switching = \frac{\sum NETWORKDAYS; \left(start\ date_{context\ switching}, end\ date_{context\ switching}\right)}{\sum \text{context switching}} \quad (13)$$

Where:
NETWORKDAYS = number of active working days (one week = 5 working days)
start date context switching = date the context-switching occurred
end date context switching = date the context-switching was the end

Based on the calculation of the raw data into the formula, the results for each metric are shown in Table 3 . The next stage is to sort each component of the EBM metric according to the data obtained. Components with a positive sign mean that the higher the score, the better. Meanwhile, the metric component is negative, meaning that the lower the score obtained, the better. Table 4 shows the ranking results of the three Scrum teams in Company A for each component of the EBM metric:

After each team is given a ranking, then it is weighted. The weighting calculation is shown in Table 5 . The weighting is used for scoring in each ranking. Rank 1 will be given a weight of K1, rank 2 will be given a weight of K2, and rank three will be given a weight of K3.

The final step at this stage is to add up the total weighted results of each metric in each team to determine the level of effectiveness of the Scrum team as a whole, as shown in Table 6 .

Based on the final calculation, it was found that the highest level of team effectiveness was the REV team, followed by the FC team, and the team with the lowest level of effectiveness was the ARR team.

5 | CONCLUSION

The components of the EBM metrics applied to Company A are Employee Satisfaction, Release Frequency, Mean Time to Repair, Customer Cycle Time, Lead Time, Deployment Frequency, Time to Learn, Innovation Rate, Defect Trends, On-Product Index, Technical Debt, Production Incident Count, Time Spent Context-Switching, Time to Remove Impediment. Some of the other EBM components are not used in Company A because the data is credentialed, and there is an additional fee to purchase

TABLE 6 The Scrum team effectiveness score calculation.

EBM Metrics	Score Each Team		
	ARR	REV	FC
Employee Satisfaction	0.28	0.61	0.11
Customer Usage Index	0.28	0.61	0
Customer Cycle Time	0.28	0.11	0.61
Lead Time	0.11	0.61	0.28
Mean Time to Repair	0.11	0.61	0.28
Release & Deployment Frequency	0.28	0.61	0.28
Innovation Rate & on Product Index	0.11	0.28	0.61
Product Incident Count	0.61	0.11	0.28
Time to Learn	0.28	0.61	0.11
Technical Debt	0.11	0.28	0.61
Time to Remove Impediment	0.11	0.28	0.61
Time to Context-Switching	0.28	0.61	0.11
Total	2.84	5.33	3.89

a license to retrieve the data. Regarding calculating the level of effectiveness of the Scrum team in Company A, the results obtained for the team with the highest effectiveness score is the REV team, with an effective value of 5.33.

Furthermore, the FC team has a fairly good effectiveness score with an effectiveness value of 3.89. The lowest Scrum team effectiveness score of the three teams in Company A is the ARR team, with an effectiveness score of 2.84. Based on the conclusions, suggestions for further research are that future researchers can provide input to increase the effectiveness of Scrum teams and evaluate effectiveness repeatedly within a certain period within a company. Periodic team effectiveness assessments are useful to determine whether the Scrum team's effectiveness is increased on the decisions taken by the Scrum Master in improvising the product development process.

CREDIT

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