CSU33012

Software Engineering

Measuring Engineering

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This report is mainly focused on how to measure software engineering process in term of measurable data and codify existing approaches in this aspect and discuss the pros and cons of different methods. It also mentions the current methodologies companies, like GitPrime and so on, are using in which systematically collect and analyze programmer's behaviour and feedback whether they are up to the requirement of being a competent or even a productive programmer as an employee working in the company.

This report starts by discussing measurable data in the process of software engineering. There is a truism in the field of management claims that you can't plan if you can't measure. Without measuring previous tasks in detail, it's impossible to extrapolate wisdom and achieve furthermore in the respective field. This methodology works so well in other human involved jobs begs the question about its practicability and reliability in the software industry.

## A.Measurable data in software engineering

A theory in software engineering approved by people who have practical jobs in computing-related companies states that the top 20 per cent of people produced about 50 per cent of the output. (HQ, 2018) It basically means that some programmers are 10 times more efficient than the other ones. However, the salary those programmers of high-performance gain fall into the same margin as other ordinary people, instead of 10 times just like their productivity. (John, 2009) It's a pressing need of figuring out ways of spotting those programmers and maintaining their performance at a high level for managers to deal with. This report starts by discussing measurable data in the process of software engineering.

### ①Measure system engineering through lines of source code or number of commits

Counting lines of source code along with counting butt in seat time can be the most two obvious and intuitive approaches of measuring programmers' productivity in software development progress. The disadvantage of this approach can be easily spotted by anyone with a programming background. Programmers can increase their productivity immensely, especially for JavaScript programmers, by at least 10 per cent through starting a newline for brackets instead of appending after existing lines. Since this approaching is often used by managers who just transfer their career into the programming world, programmers come up with a sarcastic story to make fun of these people about their software engineering method. This joke will be mentioned at the end of the report.

The number of commits is a high-level abstraction of lines of source code done during software development. It illustrates the process step by step in which simulates the mental status of the programmer, in term of cognitive understanding of the problem and evaluation of different approaches, working on the software if the programmer commits regularly. So, based on this, counting number of commits, at least, has a higher preference than counting lines of source code in the field of

measuring system engineering process.

②Measure system engineering through hour estimation and story points

Hours estimation is often used to evaluate the total amount of hours required to perform a task without interruption. (Man-hour, 2019) Story points are a collection of business needs assigned to software development. Both putting those points in order through evaluating the complexity of each point and assigning an adequate workforce to each story point are challenging. (V. & K., 2019)

Both are valid options if everything goes as prediction, but discrepancies often exist between plans and reality which lead to either crouch mode or project delay or even worse both combine. Managers often take it for granted that software engineering can be completed before reaching the estimation made by software engineers. Some problems found during the development can severely slow down the process to an extent, depending on the difficulty. It's possible that the problem is beyond each individual programmer's capability and could use the entire team to tackle down. The occurrences of problems like this, both in hour estimation and story points, may result in a reduction in their personnel assessment form the management side in which leads to frustration and resentment after completing some tasks beyond their control.

In case of software engineers deliver their products consistently on time even under unpredictable contingencies with crouch mode, manager would except to exploit the best use out of them by assigning the same or even more amount of unpractical tasks which will indubitable make employees fatigue and deprive sleep from them in the short term (Factors Contributing to Decreased Productivity, n.d.), the possibility of committing suiciding spiral which can be observed in Facebook in the long term (Rodriguez, 2019). Software engineers in the interest of protecting themselves in the confrontation with managers would posit the worst-case scenario for the process which undoubtedly causes productivity reduction.

③Measure software engineering through meta-data collected by various sensors.

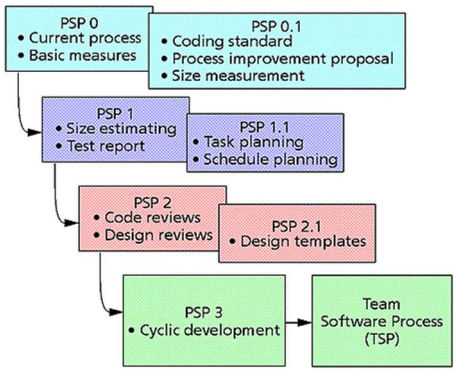
Technologies advanced to this points, tons of data can be generated from measuring daily software engineers' behaviour by little gadgets they wear or use, like Fitbit band, badge and CCTV, etc. (Sheng, 2019) Checking GPS location history of each band can illustrate an activity map of each individual engineer and cross-checking with multiple datasets can map the social groups of the company and which group hanging around all the time during the working hours. With the company calendar and a list of practitioners participate in each task, the computer can automatically exclude those from the moping ones. With facial recognition somewhere in the cubic and butt pressure on the smart chair, it can roughly deduce that the amount of time an individual spends on the desk. If this set of systems no longer detects the presence of the individual, other products outside the cubic can be notified to keep tabs on him.

⑤Measure software engineering by above all

The purpose of software engineering is to make software available to the outside world, not just for the people who build it. In light of this notion, it is the responsibility of software employees delivery progress to the company. If not delivered properly, in case of this problem frequently happens, tons of data we collect above can be used to analyze the problem emerged during the software engineering, whether it's about the difficulty of the problem beyond control or the workload of the engineers is impractical or something more personal. Only in situations like delaying project delivery on a frequent basis, the manager can be authorized to access the data to track down the problem of delaying. Extra effort is needed to ensure that everyone, including both sides of the company workers and owners, can benefit from this operation in an equitable manner.

B. An overview of the computational platforms available to perform this work

Personal Software Process(PSP) is a structured software development process that is designed to help software engineers better understand and improve their performance by introducing discipline to the way they develop software, and tracking their previous development statistics, and doing the prediction of the development and comparing the actual development with the predicted one. PSP was created by Watts Humphrey who tried to articulate the underlying principle of the software development process of a single software developer. It claims that a software developer who has a knowledge of PSP is qualified and competent to work on a software development team.




Name: Jill Fonson — Program: Analyze.java

| Date | No. | Type | Inject | Remove | Fix time | Fix defect no. | Description |
|---|---|---|---|---|---|---|---|
| 9/2 | 1 | 50 | Code | Com | 1 | 1 | Forgot import |
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| 9/3 | 3 | 80 | Code | Com | 1 | 3 | Void in constructor |

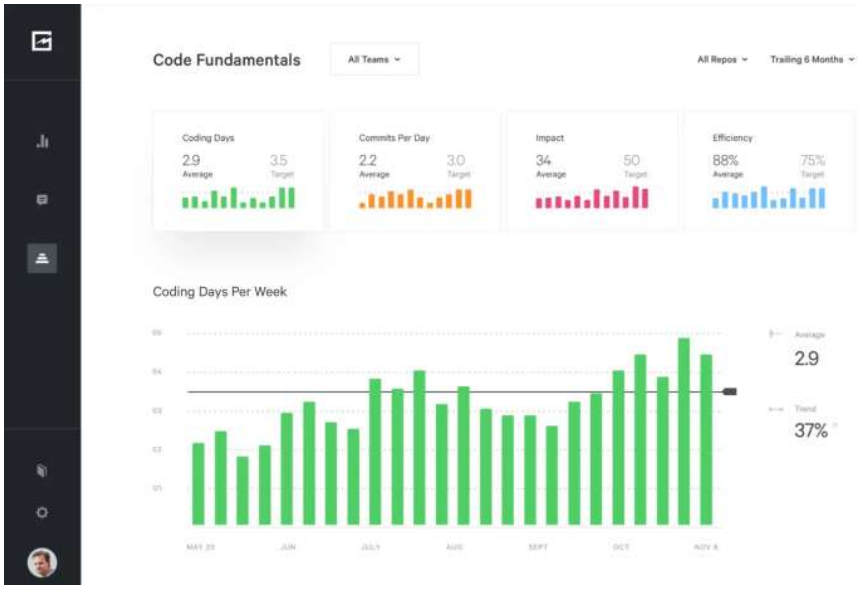
(Johnson, 2013)

PSP follows an evolutionary improvement approach. An engineer begins with learning to integrate the PSP principle into his or her process starting at first level, PSP0. The employee progresses by going through detailed scripts, checklists and templates which improve the personal understand of the software development based on PSP principle. Humphrey encourages proficient engineers to customize these scripts and templates as they gain an understanding of their own strengths and weakness.

Collected historical data is a key concept of the Personal Software Process. The accuracy and comprehensiveness of the data determine the reliability of the system. The quality of the system is highly depended on the combination of understanding of the software development process in term of the PSP principle and the faithfulness of the commitments to the dataset from the employees.

Instead of coming up new metrics system, some companies outsource this problem to other well-known companies in the field of measuring software

development process. A well-known start-up company called GitPrime, just bought by Pluralsight for $170 million cash, which delves into metrics which is designated to make engineering teams more successful. GitPrime connects to existing code repositories and ticket systems to provide a quantitative view of engineering workflows, collaboration patterns and productivity trends by aggregating historical git data into easy to understand insights and reports. GitPrime claims its capability in benefiting the user of a 21% increase in coding days per week, a 25% increase in commits per day and 20% increase in impact to the codebase.




C.Algorithm can replace people

Around 2010, there was a rapidly growing interest in the AI field. Many Fortune 500 companies started to devote a massive fund of money into the field of using AI to automate their product generalization process. Ordinary people perceive, through the time, the fact that those powerhouses intentionally and determinedly develop tools, so called Artificial Intelligence, to replace their workers. As AI has grown smarter, the number of people who wonder the chance of keeping their job in the future is growing, especially after google showing the ability of their new AI voice assistant which is capable of misleading a receptionist in a booking haircut scenario (Google, n.d.).It's a shame that later, it has been proved that Google hires people working in a call center to complete orders from duplex users. The company declared that about 25% of calls through Duplex started with a human and that about 15% of those began with an automated system had a human intervene at some point. Even with the hype and exaggeration about the technology of Natural Language Processing resides in Google Duplex, the tool still reduces about 60% work in totality. The reduced time can increase exponentially if the trend of contactless survey keeps growing.

The terror was initiated by Fei-Fei Li. Back then, she was a newly-minted computer science professor at the University of Illinois Urbana. Li saw her colleagues across academia and the AI industry hammering at the same and entrenched concept, a better algorithm would make better decisions, regardless of the data, over the years.

She started ruminating on the

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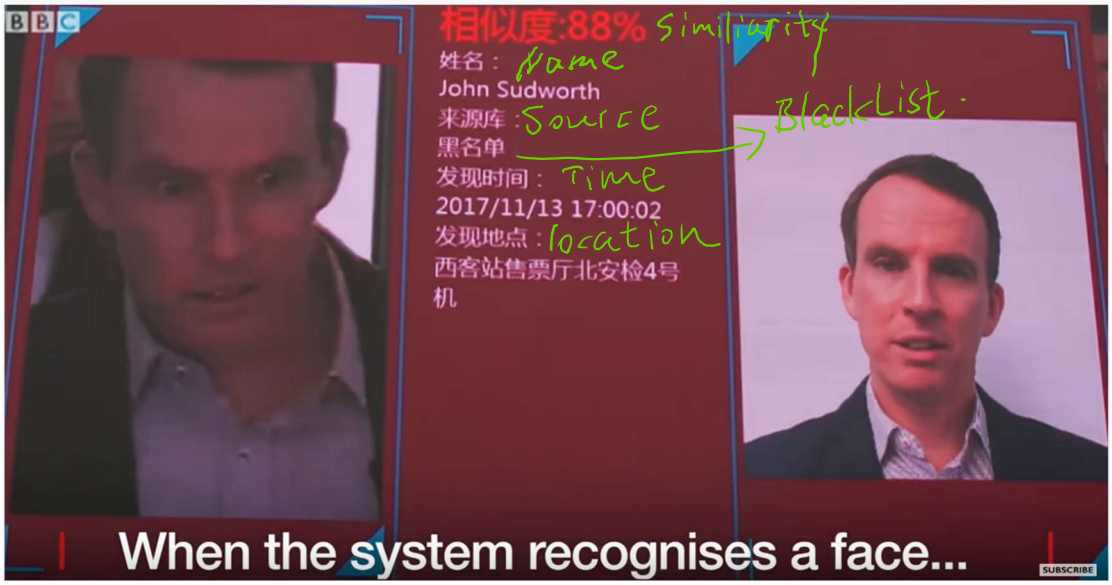
idea that the best algorithm wouldn't work well if the data it learned from didn't reflect the real world. She then decided to map out the entire world of objects to build a better dataset for algorithms to study. Within 8 years, this methodology helps the accuracy of identifying objects increased from 71.8% to 97.3%. This philosophy swept through both academia and the industry, those tech giants realize that the data they collected over the years is a previously undiscovered gold mine, and the best part is that the ownership of gold mines belongs to them. Since then, many well-known companies who have a solid place in their own field for a long time have already been captivated by the data-driven nature of the AI industry, start to step outside their comfort zone and try to grasp the trend of the world.

For further discussion, the definition of artificial intelligence should be settled. The image occurs in the science fiction in which artificial intelligence look as normal people, behave like normal people, the ability to drive cars is due to has a body like normal people is not termed AI. AI is actually defined as an object can perform certain tasks in the help of all kind of information been collected, including sensors, satellites, maps, controls, and trained by algorithm and proper datasets.AI, in the context of this definition, is just specific tools trained to perform specific tasks instead of artificial general intelligence as shown in the science fictions.Nowadays, deep learning using neural networks has become the core method for developing artificial intelligence. Deep learning uses the human brain as a source of inspiration to mimics the activities of the neurons inside our brain to which has the ability to learn and generalize from example and building concepts.

Computer vision is a subset of AI problems in which deals with how computers can be made to gain a high-level understanding of digital images.

It is now widely used in the camera function of almost every smartphone which loaded with relatively new operating systems. Camera function automatically applies this technic simultaneously as people using mobile phone taking photographs. The applicability of computer vision in this scenario is that it instructs the camera function to use different algorithm accordingly on the raw photography immediately after just been taken by recognizing the ambient environment or the target object and matching the preset option. Besides this, it allows the camera to keep focus much more smoothly while filming moving targets. These applications can be perceived through daily life by people.

There are some other uses are designated to fulfil the business's need. For instance, around 20 years ago, traffic police already applied traffic cameras which uses primitive computer vision technic on the crossroad to determine whether cars violate any traffic rules such as running a red light (LAWintel.com, n.d.). The history of this usage can go way back to the early 20th century. In 1905, Popular Mechanics reports on a patent for a "Time Recording Camera for Trapping Motorists" that enabled the operator to take time-stamped images of a vehicle moving across the start and the endpoints of a measured section of road. The timestamps enabled the speed to be calculated, and the photo enabled identification of the driver. In the past One hundred years, cameras have been equipped with high-resolution sensors and connected to a data storage centre for storing real-time footage. With the amount of data been collected over the years, computer vision has a great chunk of data which reflect the real world can be studied on. To this point, not just traffic police benefits from it, in china, police only take 7 minutes to spot and besiege a BBS news reporter who voluntarily uploads his photograph onto the face image database and ask officers to tag him as a criminal to simulate a scenario of arresting criminals. (News, 2017)




Yin Jun, Dean of Advanced Technology Research Institute of R&D Center of DaHua Technology, claims that they can match every face with an ID card and trace all your movements back one week in time and match people with their relatives and the group people are in touch with. DaHua Technology is a provider of video surveillance products and services applied in the example shown above.

In addition to traffic cameras, computer vision still has applicability in the field of monitoring and analyzing human behaviour. Recently, China Pharmaceutical University applied cameras developed by MEGVII which is also known as FACE++, in some pilot classrooms.AI monitoring and Facial recognition and analyses constitute the functionality of the camera. Those cameras are capable of detecting the identity of each individual, recognize and classify each individual behaviour, engaging with the class or playing with the phone, and deducing the mood, happy or depressed, of students by analyzing the facial subtlety during the lecture. The development of this

technology is inevitable, but there are some doubts about whether or not this will be accepted by the market or just an attempt of pushing the envelope of visual monitoring by those A.I companies.


D.The Ethics concerns

I have not found any real-life products use computer vision to monitor and analyze employee, but I believe that the technic required between student monitoring and employee monitoring are equivalent. Computer vision has already been applied in the campus, it is a matter of time for A.I companies specialize and localize this tool for the company environment if accepted by the market. The chance is slimmer for employees, except for the owner of the company, to accept the fact that multiple cameras are monitoring themselves and evaluating them base on their behaviour. Owners of companies are keen to apply it if it is been proven to have a benefit in production and since they are not the target of the system. However, if one exists in the world and the world has a movement in a fluid motion, it is inevitable for one to be influenced or being part of it.

The statement declares that employees don't accept been monitoring and evaluating by cameras is purely my intuitive thought. The following lines are based on my biased thoughts which are obsolete and inappropriate. I believe this problem can be divided into two subproblems, people hate to be monitored or to be analyzed or both.

The awareness of individual data privacy is hardening. The major factors of this change is due to the advent of the General Data Protection Regulation (GDPR) and the exposure of scandals in which companies manoeuvre public perspective by collecting social media data and mislead people in favour of companies' interest. According to a study done by Lus Laboris states that employees are becoming less likely to accept unwarranted or unexplained intrusions than ever before (MONITORING IN THE WORKPLACE, n.d.).In terms of restrictions on workplace

monitoring, the general rules are that employers must tell their employees if they are going to be monitored and must do so before the monitoring starts. The direct consent of the employee is not needed everywhere, but in some places it is. Based on the information given by citizensinformation.ie that employers are lawful to have access to employees' use of email, internet usage, phone usage and monitor employees through CCTV under the GDPR and Irish Data Protection Act 2018 if the employee is well informed and consent to the CCTV policy given by the company. (Surveillance in the workplace, 2018).This illustrates that workplace monitoring is justified by the European Commission and the Irish government.

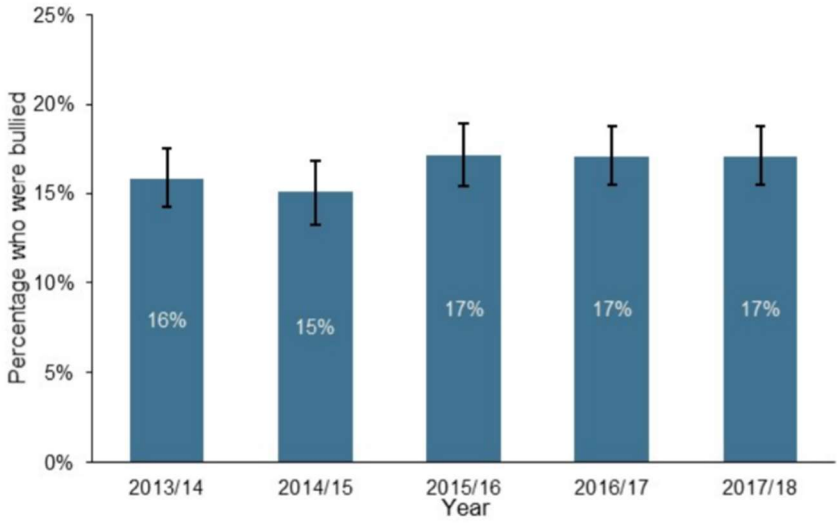
Employees compel to accept the fact that the progress of filling the workplace with cameras are inevitable no matter with their preference. In the interest of protecting employee privacy, the GDPR regulates that employees hold the right to restrict a data controller from processing their data if they consider it is unlawful or the data is inaccurate. The term of processing indicates any operation or set of operations which is performed on personal data, for example, collecting, recording, organizing, structuring, storage, adaptation or alteration, retrieval, consultation, restriction, erasure or destruction and the term of data controllers stands for organizing that collect or use personal data (Data protection in the workplace, 2018). This may sound wonderful, but the GDPR considers processing is necessary to fulfil parts of an employee's contract is a legitimate reason to process an employee's personal data (Data protection in the workplace, 2018). It seems to me this statement means that the employee is compelled to consent the processing agreement which is explicitly declared in the context of the contract if the employee wants to be hired. This approach may not work on people who on the payroll, but every newly recruited employee automatically become the target of cameras. Since companies are on the dominant side of the labor market, employees can "ostensibly" choose another company if they don't agree with the context of the contract. If all the company include the processing data agreement in the contracts, employees certainly don't have a choice, no matter their original thoughts on this problem. The association of companies are way more powerful than scattered protest groups in the field of manoeuvring public opinions and negotiating with the government and unfortunately, the human brain is surprisingly flexible and good at modulating itself to fit the environment.

In my extrapolation from the articles I read online about GDPR, I believe that there are no legislation obstacles that impede the progress of monitoring and analyzing employees using camera enhanced with A.I technology. It is poignant that employees cannot avoid the situation of being processed, including monitoring and analyzing, by employers if they want to make a living.

To be honest, in some ways, I have a predisposition in favour of being monitored in the public area and, like everyone else, the private area is not a negotiated part. With the help of analyzed data, we can gain strict enforcement of the Employment law.8 hours a day, 40 hours a week should be counted precisely and any excess minutes should be paid with a rate according to law. Employees should have the right to be unavailable outside the working hours. The data gathered within the office

should be a legitimate material to buttress the necessity of recruiting new employees to handle excessive workload instead of dumping onto employees. Companies also can benefit from the strict enforcement of the current legislation. A study observes that overwork leads to decreased total output. First, it note that in cases where overwork has been observed to lead to a decrease in total output, it must be the case that average productivity decreased enough that the total output produced under such condition in which the increasing number of hours worked per week multiplied by the decreased average productivity was actually less than the total output produced under normal work hours. Companies can benefit from employees whose total output produced eight hours per day is higher the total output produced under lower productivity.

**Figure 1: Percentage bullied in the previous 12 months**




Note: Percentages show the number of children who answered 'Yes' as a proportion of all children who answered including those who answered 'Don't know' (approx 4% per year) and 'Don't want to answer' (approx 2% per year).
Charts are produced using unrounded data but labelled to the nearest whole percentage for ease of reading.
Error bars show a 95% confidence interval for the figures.

A survey done by the Department for Education of UK estimated that in the year from April 2017 to March 2018, 17% of young people aged 10 to 15 in England were bullied in the previous 12 months in a way that made them frightened or upset and it is similar to the figure from previous years (UK, 2018). 63% of respondents who said they had been bullied in the last 12 months were asked whether the bullying had taken place at school (including on school grounds, school buses and school trips). Appling these cameras in the school area can be beneficial. Teachers can interrupt the action of bullying while it is happening rather than comfort the kid who is just been bullied afterwards. Spotting the behaviour in time can prevent more damage inflicted onto the student who is the victim of bullying and helping teachers to make a bond with the student which may have a positive impact. Besides the usage of interrupting bullying, cameras should be capable of detecting a various emergency situation. In case of any emergency happens, including but not limited to pass out, slumping and wanton people armed with knives and guns, the camera can immediately notice teachers and relevant authority.

Overall, I support all the technologies that can provide an increase in production. With production rate increases, the socially necessary labour time of commodities which are benefit from the development of technology decrease, so that the exchange value of these commodities decreases to some degree. Even though not in an equitable manner, at least, everyone can benefit from the technology breakthrough to an extent.

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