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Figure 1. Seattle Mariners at Spring Training, 2010.

Abstract

With the boom in the use of agile process model, imperfect implementations of agile are frequently being seen, out of which the problem of inter-team communication in agile teams is one of the most common issue. An agile team by its definition is a group of people who are self-sufficient to bring their responsibilities to closure, the interaction between different teams is thus considered minimal in most projects implementing agile. This causes problems when the integration of end-products of different teams is carried out. In this paper we have taken a detailed look at this problem and how we can mitigate this.

CCS Concepts • **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability.

Keywords Agile, Software Engineering, Process Models, Inter-team, Management

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1 Introduction

As mentioned in the Agile Manifesto [5], Individuals and Interactions are given more value than the processes and tools. At the same time, an agile team is supposed to contain all that is required for them to do their work, thus interactions no matter how valuable usually are done intra-team only. Thus, when a situation arrives where two or more agile teams need to work together to achieve a common goal the usual approach taken by companies fail. The agile approach of interacting in-person fails due to a few reasons such as the vertical structure of the company organization and the existence of middle managers [12]. This large number of intermediaries in inter team communication causes the process to crumble and fall apart as it takes longer than usual time for messages to reach their destination then what agile can afford. This problem is harder to fix as this is so embedded in the working culture of the current organizations that changing them will take a long time, thus an immediate patch that works is required. And that's where the approaches listed in the article comes in. We have collected a couple of approaches which if implemented efficiently results in a more stable and functioning agile process model. Thus, in the following sections we will be explaining couple of approaches we came across.

In Section 2, we will be explaining the improvements that can be made to the process and team structures to get better collaboration out of the team involved.

In Section 3, we will be explaining the enhancements that can be done in the technology stack being used and in the different ways in which technology can help in improving the process.

In Section 4, we will be describing the importance of architecture and design in resolving this issue of inter-team communication in agile.

2 Process Improvements

There are many small changes that we can incorporate in our process model to make sure that parallel developing agile teams do not run into problems when they reach the integration phase. These changes are to be made part of the entire process and are not to be implemented only in the end.

2.1 Changes in standups

One of the most critical aspect of agile process model is to have daily standups which are the platform serving the purpose of letting each team member know the work being done in the other parts of the team and corelate it with the work being done by them. This results in escalation of differences between the development early in the process and prevents end moment discovery of mismatches in interfaces and such. In the case of multiple agile teams this problem is compounded as usually a daily stand up is a closed activity of the team itself, thus preventing other teams from knowing the results or discussions of each other. This can be resolved by having a representative of each concerned team being present in the daily standup thus letting each team know the status of other teams.

2.2 Changes to Product Owner

Though in usual implementations the product owner is responsible for agile teams under his supervision, in large projects with multiple agile teams where a number of product owners are present sometimes over time the vision of the owners may get too distinct from each other thus pushing the development track in different directions. This can be limited by having regular meetings of product owners where the scope and vision of the project could be synced again. This can be a bi-weekly or monthly meeting depending on the size of the project.

2.3 Changes in Planning Sessions

All the initial, intermediate and final planning sessions should be made such that all the teams which are or could be impacted by that part of the project are part of the meeting This can assist in early agreement on high-level requirements and standardization of inter-team interfaces.

3 Technology Improvements

A good technology stack can be a powerful tool in maintaining a widely distributed team. Good communication and management tools can help the teams in keeping track of things that they need to do so that other teams can work as intended. The following are some of the areas where the technology can assist the teams in making a more efficient agile process environment.

3.1 Communication Tools

As agile focuses on personal interaction with highest importance given to face-to-face conversation, conferencing tools such as video conferencing and WebEx etc. can help the team interactions become more fluid and clearer. They also make the communication real-time thus removing the lag in process due to time spent in communicating ideas across teams.

3.2 Integration Tools

Continuous integration tools can go a long way in finding out inter-team problems early in the process as every time any team makes a change, its impact on the entire project can be seen.

4 Importance of Architecture/Design

As we know that the product owner in an agile process model is the person with the vision of what the project will look like and if it is a small team the product owner can clearly pass this to each and every member of the team and even each member can query the product owner directly when in doubt. But in large scale projects where multiple agile teams are working together in supervision of a few product owners it is practically impossible for the owner to keep doing what they did in a small team, that's where a formal definition of their vision comes in handy as it enables the teams to look up to something when encountering a design decision. The design or architecture in this case acts as a common vision for not only the teams but also for the communication between all the product owners. The design acts as a "deadlock breaker in decisions" [36] as when the teams can't come to a common consensus the design shows the path to take.

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Table captions are placed *above* the table.

Because tables cannot be split across pages, the best placement for them is typically the top of the page nearest their initial cite. To ensure this proper "floating" placement of tables, use the environment **table** to enclose the table's contents and the table caption. The contents of the table itself must go in the **tabular** environment, to be aligned properly in rows and columns, with the desired horizontal and vertical

Table 1. Frequency of Special Characters

Non-English or Math	Frequency	Comments
Ø	1 in 1,000	For Swedish names
π	1 in 5	Common in math
$	4 in 5	Used in business
Ψ_1^2	1 in 40,000	Unexplained usage

rules. Again, detailed instructions on **tabular** material are found in the *LaTeX User's Guide.*

Immediately following this sentence is the point at which Table 1 is included in the input file; compare the placement of the table here with the table in the printed output of this document.

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13 Math Equations

You may want to display math equations in three distinct styles: inline, numbered or non-numbered display. Each of the three are discussed in the next sections.

13.1 Inline (In-text) Equations

A formula that appears in the running text is called an inline or in-text formula. It is produced by the **math** environment, which can be invoked with the usual `\begin . . . \end` construction or with the short form `$ . . . $`. You can use any of the symbols and structures, from α to ω, available in LaTeX [22]; this section will simply show a few examples of in-text equations in context. Notice how this equation: $\lim_{n\to\infty} x = 0$, set here in in-line math style, looks slightly different when set in display style. (See next section).

13.2 Display Equations

A numbered display equation—one set off by vertical space from the text and centered horizontally—is produced by the **equation** environment. An unnumbered display equation is produced by the **displaymath** environment.

Again, in either environment, you can use any of the symbols and structures available in LaTeX; this section will just give a couple of examples of display equations in context. First, consider the equation, shown as an inline equation above:

$$\lim_{n\to\infty} x = 0 \tag{1}$$

Notice how it is formatted somewhat differently in the **displaymath** environment. Now, we'll enter an unnumbered equation:

$$\sum_{i=0}^{\infty} x + 1$$

and follow it with another numbered equation:

$$\sum_{i=0}^{\infty} x_i = \int_0^{\pi+2} f \tag{2}$$

just to demonstrate LaTeX's able handling of numbering.

14 Figures

The "`figure`" environment should be used for figures. One or more images can be placed within a figure. If your figure contains third-party material, you must clearly identify it as such, as shown in the example below.

Figure 2. 1907 Franklin Model D roadster. Photograph by Harris & Ewing, Inc. [Public domain], via Wikimedia Commons. (https://goo.gl/VLCRBB).

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Figure captions are placed *below* the figure.

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A "teaser figure" is an image, or set of images in one figure, that are placed after all author and affiliation information, and before the body of the article, spanning the page. If you wish to have such a figure in your article, place the command immediately before the `\maketitle` command:

```
\begin{teaserfigure}
 \includegraphics[width=\textwidth]{sampleteaser}
  \caption{figure caption}
  \Description{figure description}
\end{teaserfigure}
```

Table 2. Some Typical Commands

Command	A Number	Comments
\author	100	Author
\table	300	For tables
\table*	400	For wider tables

15 Citations and Bibliographies

The use of BibTeX for the preparation and formatting of one's references is strongly recommended. Authors' names should be complete — use full first names ("Donald E. Knuth") not initials ("D. E. Knuth") — and the salient identifying features of a reference should be included: title, year, volume, number, pages, article DOI, etc.

The bibliography is included in your source document with these two commands, placed just before the \end{document} command:

```
\bibliographystyle{ACM-Reference-Format}
\bibliography{bibfile}
```

where "bibfile" is the name, without the ".bib" suffix, of the BibTeX file.

Citations and references are numbered by default. A small number of ACM publications have citations and references formatted in the "author year" style; for these exceptions, please include this command in the **preamble** (before "\begin{document}") of your LaTeX source:

```
\citestyle{acmauthoryear}
```

Some examples. A paginated journal article [2], an enumerated journal article [8], a reference to an entire issue [7], a monograph (whole book) [21], a monograph/whole book in a series (see 2a in spec. document) [15], a divisible-book such as an anthology or compilation [10] followed by the same example, however we only output the series if the volume number is given [11] (so Editor00a's series should NOT be present since it has no vol. no.), a chapter in a divisible book [32], a chapter in a divisible book in a series [9], a multi-volume work as book [20], an article in a proceedings (of a conference, symposium, workshop for example) (paginated proceedings article) [3], a proceedings article with all possible elements [31], an example of an enumerated proceedings article [13], an informally published work [14], a doctoral dissertation [6], a master's thesis: [4], an online document / world wide web resource [1, 26, 33], a video game (Case 1) [25] and (Case 2) [24] and [23] and (Case 3) a patent [30], work accepted for publication [27], 'YYYYb'-test for prolific author [28] and [29]. Other cites might contain 'duplicate' DOI and URLs (some SIAM articles) [19]. Boris / Barbara Beeton: multi-volume works as books [17] and [16]. A couple of citations with DOIs: [18, 19]. Online citations: [33–35].

16 Acknowledgments

Identification of funding sources and other support, and thanks to individuals and groups that assisted in the research and the preparation of the work should be included in an acknowledgment section, which is placed just before the reference section in your document.

This section has a special environment:

```
\begin{acks}
...
\end{acks}
```

so that the information contained therein can be more easily collected during the article metadata extraction phase, and to ensure consistency in the spelling of the section heading.

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17 Appendices

If your work needs an appendix, add it before the "\end{document}" command at the conclusion of your source document.

Start the appendix with the "appendix" command:

```
\appendix
```

and note that in the appendix, sections are lettered, not numbered. This document has two appendices, demonstrating the section and subsection identification method.

18 SIGCHI Extended Abstracts

The "sigchi-a" template style (available only in LaTeX and not in Word) produces a landscape-orientation formatted article, with a wide left margin. Three environments are available for use with the "sigchi-a" template style, and produce formatted output in the margin:

- sidebar: Place formatted text in the margin.
- marginfigure: Place a figure in the margin.
- margintable: Place a table in the margin.

Acknowledgments

To Robert, for the bagels and explaining CMYK and color spaces.

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A Research Methods

A.1 Part One

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A.2 Part Two

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