

Supplementary Material

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I. CONSTRUCTS

We present all constructs that we used at coding time in this section. These constructs are used as codes to analyze interview transcripts.

Managers & Mentors Managers and mentors directly influence a new member's onboarding experience. They assign tasks to the developer and support the developer to successfully onboard the team.

Landscape New members need to learn the team's landscape. Therefore, the team's landscape influences the developer's learning experience. Lack of documentation or bad documentation, in particular, causes bad learning experiences.

Previous Experience A new member's previous experience influences how managers choose tasks. Seniority is a significant factor that influences managers' decisions. Besides, newly hired developers may have different onboarding experiences from developers transferring from within the organization. This is particularly obvious for junior developers, as they need time to learn development workflows, tools, and practices.

Confidence New developers become more confident in their team roles as they onboard. The paper presents more details about confidence.

Pressure Most managers try to avoid putting external pressure on new members. Accordingly, most developers have mentioned that their pressure was self-inflicted. A major source of pressure is the developer's wish to prove themselves.

Psychological Safety It can be intimidating for new members to ask for help or ask questions due to a fear to appear incompetent or inexperienced and losing the respect of others. The psychological climate dictates how new members perceive the likelihood of negative social consequences, and therefore, shapes their onboarding experiences.

Motivation New members want to prove themselves, which gives them pressure but also motivates them. Besides, tasks with an impact motivate new members. Some new members are also motivated by deadlines.

Trust Trust improves a new member's confidence and motivation. Developers gain trust from owning a part of the team's product. Specifically, being asked for help is a signal of trust for most developers.

Learning New developers need to learn everything about the team: code repositories, business values and customers, development tools and processes, and responsibilities of each individual member and some other close teams. The paper presents more details about learning.

Social Interactions Successful onboarding means positioning oneself in the team and owning a part of the team's work. The paper presents more details about social interactions.

Progress Productivity is not a high priority for managers when onboarding new members. However, productivity becomes more important when the team has urgent needs, such as teams that use the Priority-First strategy to onboard new developers.

Training Developers have mixed feelings about training and boot-camps that happen at the beginning of a new job. Some developers think they are superfluous, while others appreciate the big picture of their work. In some cases, training is disruptive because it interrupts the task.

Setup Most new members need to set up environments in the first few days. This is necessary but sometimes annoying when the process takes too much time and blocks the developer from working on tasks.

Meetings Meetings include ad-hoc onboarding meetings and technical meetings. Onboarding meetings are useful to clarify the big picture and prepare new developers for their first few tasks; they are also opportunities for new developers to seek for help. Technical meetings are good learning opportunities for new developers; new developers may also receive positive feedback from technical meetings such as daily stand-ups, which boosts their confidence.

Social Events Managers use social events, such as team lunch and team rooms, to connect the new member with the team. Developers also reported that they benefited from social events.

II. QUOTES

We present more quotes to support our interview findings. These quotes are organized according to interview findings. We use **P_i** to refer to developers and **M_i** to refer to managers. *Quotes are emphasized like this sentence.*

E1.1 Maintaining a documentation that is complete, clear, updated, and well organized is an effective way of facilitating learning for new members.

Out of 32 interviewed developers, 12 regarded documentation as an important source of information. Documentation is useful for new developers to learn many things: **P2** used documentation to learn development processes, **P8** and **P28** used documentation to learn the new team's internal tools, **P6** and **P19** used documentation to learn new technologies and languages, and **P17** used documentation to learn the team's product. Therefore, keeping a good documentation can be critical for learning.

Bad documentation causes troubles for new developers. **P1** found no documentation for *live site issues* and that caused problems because *the problem is that it's hard to go to them (mentors) for a small thing yet there isn't documentation*. **P5** thought that *the documentation is not good especially for*

a new hire. He/She said *he/she did ask my manager about the documentation and he said there is none and some of it resides in his laptop which was sent to him/her later*. He/She confirmed that *documentation is the key part that is missing and that lack of documentation makes it tough for him/her*.

Many new developers considered indexing resources important. **P14** complained that *the team's documentation is too scattered and there is a lot of tribal knowledge*. **P20** also said that *the guides spread across multiple sites, (so) the information is there but takes time to find*. Accordingly, many developers recommended a checklist or a guide for finding resources. **P2** wished that he/she had *bookmarked the appropriate areas of wikis (because) it was easy to forget about what wiki pages exist and what they cover*. **P11** recommended the team to *put this process through the video, or more documentation to help*.

Some managers expect new developers to keep documentation updated. **M13** said that *new members can enhance the document at any time when they find some issues*.

E1.2 Creating a safe and supportive environment where new members can ask questions freely is an effective way of facilitating learning for new members. Developers learn frequently from co-workers. **P2** said *one of my co-workers is helping me to learn about part of the architecture and he/she met with co-workers to learn more about the scenarios about the product, source code, different tooling used*. **P31** believed that *if people are willing to help in the first few days, it would make people on-board quickly*. **P29** found that *the review comments revealed that something the team cared were surprising and it's challenging to learn stuff like this*.

Having a low-cost channel for seeking help facilitates the new developer's learning. **P3** said *he/she used to ask them questions during the standup. Asking questions helped he/she more and now he/she feel more equipped*. **P8** mentioned that *his/her (onboarding) buddy sits in adjacent team room, so he/she felt free to talk to him if he/she had questions, or reach out to him on (an instant message app)*. **P25** pair programmed with his mentor and found it very helpful for ramp-up; he/she felt *comfort in making mistakes in front of his mentor*; he/she further explained that *he/she tried to stay as transparent as possible instead and he consciously tried not to be worried about making mistakes in front of my mentor*.

E1.3 Team meetings, such as daily stand-ups and sprint planning meetings, are useful opportunities for new members to learn the team's big picture. New developers learn from attending meetings. **P3** said that *The more he/she attended the meetings the better he/she learned*. **P9** said that *he/she learned what the team is working on from lunch meetings*. **P11** said that *in meetings, more pieces of big picture showed up connecting his/her work with others*. **P30** said that *(the team) had a lot of meetings like team meetings and one on ones to convey the ideas and what's happening; those were very helpful (for learning)*. New developers typically learn new information when attending meetings, but some meetings are also opportunities for them to have their questions answered. For example, **P13** would *bring up the questions during weekly*

sync up or standup.

Some managers expect new developers to learn from team meetings as well. **M7** expected new developers to *attend presentation and talks within the larger organization to understand what's going on in the large organization*. **M13** set up *brown-bag sessions where team can pick a topic and come to present it* so that new developers can learn new technologies.

E1.4 Explaining the team's big picture (such as visions, missions, and plan) is an effective way of facilitating learning for new members. **P10** found it helpful that *a senior engineer on the team spent a couple of hours with him/her to give an overview of the product and architecture*. **P13** found an overview presentation helpful for him/her. **P15** found a *small on-boarding session covering tools, infrastructure, design, and tools* helpful.

Many managers explain the team's big picture first before assigning any tasks. **M5** would *explain overview of what the team does so (new developers) understand the bigger picture, and how the team fits in to (the organization)*. **M7** said: *"A perspective about how customers are using the work is important to motivate people and make them effective."* **M14** said that a new developer's task for the second week was *learning the customer's perspective*.

E2.1 Enabling new members to deliver tasks frequently is an effective way of building up a new member's confidence. New developers gain confidence by delivering tasks. **P17** said he/she *become more confidence because the project is delivering value*. **P30** felt that *people from the team started to trust him/her after he/she finished a task*.

On the other hand, new developers feel stressed and low confidence when they cannot deliver fast. **P5** said that *talking about the same thing on daily meetings gave him/her pressure*. **P26** said: *"At times I feel a bit down because I work on design but don't produce anything. Few bug fixes or small features would have been more useful in my onboarding experience."*

Most managers consider building confidence more important than delivering tasks for new developers. **M2** said: *"We should focus on building confidence for onboarding, not time and count of bugs created."*

E2.2 Providing frequent positive confirmation and trust from the team is an effective way of building up a new member's confidence. Feeling trusted by the team improves a new developer's confidence. **P8** got the team's feedback from code reviews, and *that made him feel good to have trust so early*. **P16** felt confidence because *the team trust him/her to handle follow-up and be the owner of new features; they also trusted him/her to communicate with user and collect feedback*. **P18** said that *confidence comes with team member observing you over time and reaching out to you for work in your area*. **P22** felt that *his/her opinion would be heard and included (and) that was a very positive (for confidence)*.

On the other hand, not having feedback would hurt confidence. **P23** worked on a cross-team task and had many pull requests left not reviewed; he/she felt that *a small feature would've been better, especially which has less cross-team collaboration, where his/her work is reviewed faster*.

E2.3 New members build up their confidence as they learn more about the team's landscape. P3 said: *"The more I see the more I became confident."* P12 re-read wikis to gain confidence. P15 also said that he/she grow more confident as learning. P20 said: *"if I spend time doing some research and learning, I feel confident."*

E2.4 Explaining a task's big picture and clarifying the specifications is an effective way of building up confidence for new members. P8 said that *after having a few meetings with the manager and onboarding buddy to understand requirements and the task was clear and felt more "normal"; (so) understanding the requirements clearly were related to gaining confidence.* P23 had a meeting with his/her onboarding buddy and felt that *having the questions answered helped the confidence.* P26 worked on an open-ended task, but he/she preferred tasks that *gave a concrete set of specification and felt that those tasks would build confidence more.*

Meanwhile, failing to get the big picture or specifications causes lack of confidence. P11 felt lack of confidence because the business value was unclear. P15 felt difficulty because the task lacked specifications and was too vague. P30 joined the team in the middle of a reorganization, and he/she said: *"It wasn't clear where the organization is going; it was arduous to understand what the team was going on; I kind of feeling what am I doing, am I losing my job, who is my team, and what is my team working on."*

Some managers consider a task's scope and clarify the most important feature when assigning tasks for new developers. M4 said: *"(I would) give a problem that I have a solution in mind or a problem that they can arrive a solution from the question."*; M4 further explained that *(new developers) should be confident about the process, so when the test fails, they know it's not their fault.* M9 assigned tasks that are very clear and defined, and explained that *he/she wants to make sure people understand, because his/her organization is usually lightweight in terms of docs and he/she doesn't want them to be confused.* M11 mentioned that *it's important that there are clear deliverables.*

E2.5 Creating an environment where new members feel safe and supported is an effective way of building up confidence for new members. P1 felt comfortable since *he/she has seen others made mistakes.* P21 felt that *he/she never thought it would fail because people were there.* P25 said that *he/she was aware that there were plenty of things that he/she didn't know, but he/she knew there were others who knows what he/she needs to know, and he/she was confident that there were people he/she could get help from.*

However, new developers may feel insecure and that would hurt onboarding. P2 said that *he/she worried too much to not bother the team, (which) made it take longer to work on tasks.* P14 also mentioned that *some team members are so busy so he/she didn't ask them everything.*

Managers also expect that new developers can get confidence from the team's support. M2 said that *"if someone picks a very complex task that could be challenging to have confidence in, this should be alleviated or helped by the fact*

that the person will be working closely with someone who is more experienced in that area". M6 mentioned that *he/she feels that the new hire will be more confident if they pair on the first task.* M10 said that *the best practice is to have someone help (new developers) so they don't feel alone.*

E3.1 New members build up social connections with the team faster and easier when they can interact frequently with the manager and mentor. Mentors and managers can introduce the new developer to the team. P7 said that *the manager would introduce him/her to the new person.* P12 said his/her manager makes sure that he/she is getting any help that he/she needs from the team.

Some developers preferred mentor whom they could interact with more. P5 had a mentor, but the mentor *didn't know about the code or the feature*, so he/she had no frequent interactions with the team; he/she said: *"it would be better to have a specific task based mentor rather than a generic dev set up mentor."* P18 also said: *"a mentor was assigned to me or somebody who is more involved then it'd be better."*

Most managers mentioned that mentors are important. M2 emphasized that *sometimes he/she's also switched mentors for someone to better suit them and that it takes an iterative approach to onboarding.* M4 said that *mentor should devote significant time in the first three weeks.. and pair with them to work and research.* M9 wanted mentors to *communicate well ... and can make time to help a new developer.*

E3.2 Having a low-cost channel for new members to seek help from the team is an effective way of facilitating a new member to build up social connections with the team. P4 worked remotely but his/her onboarding experience was good; he/she could ask questions in a dedicated instant message channel and got help from experienced developers fast. Code reviews are also useful channels for communication. P13 said that *code review process is pretty transparent and people are very open to talk about issues.* P14 said that *when people do pull request reviews, the guidance is to give them direct feedback about what could be improved.*

Managers expect that low-cost channels would encourage communications. M3 said: *"we are in the team room together..It's a matter (for new developers) to learn how to reach out."* M7 used *standup meetings to help people to get connected.* M12 thought that *open space team rooms help make it easy to ask questions.*

E3.3 Assigning tasks that require the new member to collaborate with various team members is a effective technique to help new members to build social connections. P16 said that *if he/she didn't work with co-workers regularly, he/she wouldn't know what they work on. So he/she learns about his/her co-workers based on the work assigned.* P24 felt that *(a task) did help him/her connect to some team members well because he/she had to work with senior people in his/her sub-team to learn about architecture and design.*

Meanwhile, isolated tasks may cause the new developer to feel isolated. P8 said that *he/she has interactions with about half of the team, so he/she's only been interacting with the team members that are working on similar things to him/her;*

he/she's not sure what the other team members work on. P10 said that since the tasks are small, he/she doesn't need to talk with co-workers much.

Managers would also use tasks to connect the new developer to more people. **M4** said that *when (new developers) are able to work more independently, he/she tries to assign tasks that connect people better. M6 would try to find tasks that the mentor and new hire can work on together. M8 described tasks as tasks (new developers) work on spread across areas of the team so they can meet multiple team members. M14 would assign tasks that introduce (new developers) to the team, so they can build trust and also help the design.*

REFERENCES