TABLE II: Codebook of the onboarding observation study showing excerpts of codes extracted from the transcribed data, with description and example codes.

Code(s)	Description	Examples
Self motivation	Participant who join the onboarding program are expected to be self-motivation; wiling to dedicate time for the two days training and to learn in a collaborative atmosphere.	M_1 : "Onboarding at OpenStack is an intensive program designed for newly graduated student in mind who are motivated and about to start their carrier in open source ecosystem such as OpenStack but lack the technical know-how."
		TESTIMONY3:" I found that being proactive and managing those expectations has worked the best for having successful mentor-mentee relationships."
Active com- munication	To participate in a large scale open source distributed Software development process, contributors should have a solid communication skill set	M_1 : "Moreover, M2 emphasized on IRC and the mailing list as the main communication Medium"
		TESTIMONY4: "I mean setting up goals even just as a mentee yourself and then again communicating those clearly to your mentor I think has been the best way for me to sort of track my progress and stay focused."
		M_5 : " told participants to be consistent within and be on top of the reviewer's comments. Moreover, urge participants to be patient during the review period and be communicative and collaborative "Remember this is an open-source world! Things happen on the community schedule, not yours."
Collaboration Mentor- Mentee	Open source software development is a human centered activity that needs a great amount of collaboration especially in large	TESTIMONY3 : "I found that being proactive about that and managing those expectations has worked the best for having successful mentor-mentee relationships."
	ecosystems. Moreover, there are different types of collaboration which we observed. Mentor-mentee for example facilitates for knowledge transfer.	"Active workplace mentoring helps mentees attain mature technical skills required to grow in their workplace, mentoring helps manage immature skill sets required to grow into a senior engineering role in the future"
Impostor Syndrome Effect	Joining/participating in a global team of diverse skills/talents can be challenging given that contributors are found different cultural background, educational setting, etc. However, it's important to understand this Effect to mitigate it.	TESTIMONY3: "So, as a new developer fresh out of college coming into any new team can be very intimidating. [deep silent for a moment] Everyone around the kind of knows so much more than you and you feel that you're an imposter with so much to learn there's"
		TESTIMONY7: "Active workplace mentoring helps mentees attain mature technical skills required to grow in their workplace, mentoring helps manage immature skill sets required to grow into a senior engineering role in the future. So, the maturation of those technical skills may also help alleviate impostor syndrome as most of us are likely familiar with."
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Code(s)	Description	on from the previous page. Examples
Ecosystem (SECO) specifics	Ecosystems are different from project, hence, there are different tools and processes that ecosystem use in software development and coordination that needs ecosystem wide concern to operate. For example, issues trackers.	M_1 : "Besides, in an ecosystem, the design paradigm is different and depends on domain knowledge. In addition, In an ecosystem, cross-project collaboration is the force that builds a community into an ecosystem but such is not the case with an individual project."
		P_2 : "Storyboard was engineered to support the coordination of cross-project work in an ecosystem setting, in which each project is different in the process of reporting bugs and planning new features, for example, a story could be to invent some new feature A, and tasks would be changed in project X, change in project Y, and change in project Z. Those changes need to merge in order to complete feature A."
Ecosystem Best practices encouraged	Best practices practices that they encourage among dif-	M_2 : "You might have noticed that the feedback that mentors provided were actually the writing approach they expected you to write specifications and that is the best practice that we encourage."
		P ₃ : "To check the differences between your branch and the repository: git diff master Assuming you have not added new files, you commit all your changes using: git commit -s -a Read the Summary of Git commit message structure for best practices on writing the commit message."
Return on Investment (ROI)	Companies are involved in the running of OpenStack ecosystem, and some of these companies actually sponsor the onboarding events. Moreover, sponsoring companies will always want some benefits or return of their investment.	TESTIMONY4: "Mentoring is also a sound business investment. Teams and enterprises cannot afford to lose their top engineering talent as the needs of the business evolve, especially in industries where disruptive technologies result in an extremely competitive pool of talent."
		FP_1 : "However, the return of that investment can be very high. Investment in mentoring is key to staying competitive and keeping employees happy so in the long run yes mentoring can be an investment on behalf of you know the company but it pays out dividends later on."
		P_5 " really captured it. It's the culture of the place that helps drive the behavior you want you can sort of sell it to leadership as it's an investment and it's it brings you business value and it helps retain talent because it keeps people happy and it increases skills that are hard to find in the marketplace"
Events	Ecosystems frequently organizes events to bring about contributors/organisations and different stakeholders to discuss and share common values.For example, Onboarding	M_1 : "We strongly recommend the constant consultation of the online documentation as we ourselves are constantly referencing them throughout this training event. Read, read and Read your documentations."
	usually occurs during the main ecosystem summit.	M_7 : "said "After the 2-Days onboarding event, participants can sign up for a longer-term mentoring program to further strengthen their skills and become more productive and successful in the community. — That's the way to transform learners into practitioners."
		Continue on the next page.

Code(s)	Description	Examples
Code Quality/Guideline	It is important to write code that are robust and less buggy, thus improving code readability and testing.	M_1 "Hacking style guide was enforced by reviewers manually, but the process has been automated. Therefore, hacking makes code written by many different authors easier to read by making the style more uniform. (example: Unix vs. windows newlines)"
		M_7 "Based on many years of practical experiences doing code development, bug troubleshooting and code review across OpenStack projects and other communities such as Linux kernel, CoreUtils, GNULIB, etc., we suggest a fairly common practice, which is motivated by OpenStack strong desire to improve the quality of it's projects' Git histories."
		M_1 " to ensure high quality code, OpenStack recommends some syntax checks Frameworks such as: (eslint-configopenstack, Hacking, bashate, etc.), and enforces the OpenStack Coding standard."
Teams	Group of dedicated people that meets weekly and on other several occasions to discuss about specific project. Each project is run by a team.	TESTIMONY2 "So, contributing to an upstream project is so much more than just being added to a new team, there are now people all over the world that you have to deal with. It's a lot like having another person act as a mentor is like having an interpreter."
		P33/35: "P35 seated on table/group 10, were exchanging ideas constantly throughout this exercise 1, therefore, OB1 moved to table 10 and asked both P33 and P35 how they found the exercise and if they could walk him through the steps that they took in doing the exercise. P33 said "this was my first time working with git. At school, I did mostly theoretical computer science and mathematics, I know the logic and algorithm behind most code but have not been exposed to real situations. So it was."
Training programs	The onboarding process of OpenStack aim at improving productivity and quality code contributions.	M_1 : "Onboarding at OpenStack is an intensive program designed for newly graduated student in mind who are motivated and about to start their carrier in open source ecosystem such as OpenStack but lack the technical know-how. We give them materials and hands-on training that equips them to master the tools, which they will use in making contributions to the codebase; add new features, fix-bugs, write documentation and participate in working groups to OpenStack as they join a community of thousands of developers from hundreds of companies worldwide."
		M_2 :"The best way to maintain a healthy community is to educate newcomers and give them the tools they need to become effective contributors. One of ways OpenStack does this is through the two-day long Upstream Institute Training offered prior to each OpenStack Summit"
	1	Continue on the next page.

TABLE II – Continuation from the previous page.		
Code(s)	Description	Examples
Project(s)	These are individual units that forms the interdependent services in the ecosystem; OpenStack projects provides services to end-users.	M ₂ :"Project Onboarding gives participants a chance to meet some of the project team and get to know the project. Participants will learn about the project itself, the code structure/ overall architecture, etc, and places where contribution is needed. Participants will also get to know some of the core contributors and other established community members. Ideally, participants will know/ have completed the OUI basics"
Critical/ Analytical thinking	Ways of approaching problems mentally from an abstraction on making a reasonable solution, to breaking down these complex problems into meaningful and basic/simple solutions.	P ₃ : "I chose Keystone based on what the mentors presented yesterday about the core OpenStack projects, and what I have searched so far, 'Keystone service provides API client authentication.' At school, I work with projects that implement identity authentication as services to web-based applications. So, I am most comfortable with this way of writing coding and thinking."
		P_70 : "I realize that reviewing the work that my teammates have done makes me see contributing to a project differently. For example, I was limited to my own ways of thinking but now I realize that when I read a teammate's logic and get lost, I know exactly where I don't understand and I ask questions for clarification. Also, I have learned something new that I did not know."
		P_67 : "In my experience, I noticed that I can easily find something wrong on what someone has done rather than seeing something wrong on my code or what I have done. The review process stands out as most exciting for me because my critical mindset was more activated than just focusing on my own work, I try to see things through the lens of what someone has done to make sense out of it, that is exciting."
		TASK2: "In most cases, mentors questioned the rationale of participants rather than answering their questions directly, this guided participants to think deeply and figure out their own solutions."
Mission/ guiding principles	The mission statement of the SECO OUI training program forms a guiding principle of its modus operandi.	M_1 : "The program was built with the principle of open collaboration in mind and was designed to teach attendees how to find information, as well as how to navigate the intricacies of the technical tools for each project."
Project Level (PL) Tools practice	Besides being a SECO, OpenStack constitutes a wide range of interdependent project teams. Thus, OUI ensures that participants get familiar with both the project-level and SECO level tools and processes.	M_1 : "Originally, OpenStack used Launchpad as the issue tracker, Launchpad was developed and managed by Canonical to track bugs or blueprint. Moreover, Launchpad is limited in terms of scope. It was tied down to a project, it was not designed to support an ecosystem scope i.e a cross-project setting."
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Code(s)	Description	Examples
Feedback from Mentors	Re-reinforcement learning is an integral part of the OUI program. Participants	M_2 : "Use every opportunity you have to give us feedback. It's important for the community."
	are exposed to learn from the expertise of mentors through constructive feedback mechanisms	M_7 : " I prefer to fail fast and regular and get rapid regular feedback from the individuals that I have these relationships in the workplace so I can course-correct and find ways to augment that relationship with"
		TESTIMONY4: " finally feedback is critical to determine the effectiveness of a mentoring arrangement."
Knowledge on community concerns	It's important to have a functional knowledge on the ecosystem wide concern. This knowledge encompasses the technical demands of a particular project, but goes beyond to include the structure of the organization/ecosystem, such as leadership, communication mediums, events, etc.	M_1 : "If we remember the early days of the internet, it was the LAMP (Linux, Apache, MySQL, PHP) stack that enabled the rapid growth of the Web. In this era of cloud computing, OpenStack is the 'LAMP stack' of the cloud. The same way the Linux kernel is different from Apache server, and MySQL DB, and PHP, so too is how the different projects within the OpenStack ecosystem differ from one another. Yes, all use Python but that is it"
		M_3 : "go on-line and search the release cycle of OpenStack and how many releases are there in total."
		M_6 : " how many core projects exist at OpenStack and how who are the project team leads (PTL) of Nova, Swifts, Cinder, Neutron, and Manila? 'The first participant who submitted the right answer on the IRC channel was rewarded same goes for all the other mentors as they did their presentations on the structure and functioning of OpenStack cross-project teams and the ecosystem in general."
		M_11 : "Pay attention to who is an 'expert' in your project domain, don't forget to post and ask questions in the channel or send direct messages. Remember that If people know you, you have a better chance at your code getting attention."
Environment and account Setup	Having a working/functional environment with the right configurations is required to be an active contributor to a SECO.	M_1 : "Make sure the following are install and running:-Install Virtualbox on your host machine with the Ubuntu image, Install DevStack on Sandbox Environment, Install Git, Gerrit, Python3, Editor (Vim, Sublime, SPE, or any other open-source tool)."
		M_1 : "Run the test script in the Devstack folder to make sure your local environment is properly configured and up to date. In case you run into trouble, call any mentor to help you."
		M_10 : "Make sure you configure your Gerrit account: open the Setting Up Your Gerrit Account section of the Contributor Guide. Read the material and ask questions to the mentors, then get ready to go through the exercises."
	1	Continue on the next page.

TABLE II – Continuation from the previous page.		
Code(s)	Description	Examples
Contribution workflow	There are different kinds of workflows (arranged under different task headings). However, once the technical requirement is ascertained, contributors can start making a contribution by following a particular workflow at any assigned/given task.	M_5 : "Gives the general contribution workflow, which consists of picking a task (this could be a bug, trivial fix, documentation, implementation), creating a new branch in your local repository, making the desired code change, adding and running test cases, last, create your commit and push the changes back upstream for review."
		M_5 : "we will go into this later on in more detail so hold off on answering detailed questions for now."
		M_23 : "Why is OpenStack using multiple task tracking systems? What are the main differences and drawbacks?"
		M_35 :"I used git a lot at college in nearly all my software engineering courses and projects, therefore, I find this exercise pretty straightforward. Except for the launchpad thing that I am using for my first time today, but overall, the exercise is not that hard for me."
Reward harvesting	Incentives and reward policies are used to motivate participants throughout the OUI training program.	M_2 : "motivated participants that in each series of exercises, the first person to finish and notify the mentors on IRC or on their table will receive a prize. There were varieties of prizes for everyone such as swags, Lego, stickers, tickets for free summit outing events, etc."
		P_3 :" responded 'git review -s' and M2 rewarded P3 with a sticker M1 added Git review is a tool maintained by the OpenStack."
		<i>OB</i> 1: "noticed that the first participant to create and register a blueprint is participant P13 and it took 19 min tho do so, mentors gave P13 a sticker. Meanwhile, the last participant finished in 27 min."
New features/ Design activi- ties	The evolution of a SECO are possible when contributors propose/ submit new features/blueprints. Some of the features are complex and immediately triggers collaboration.	P_{27} : "It was a straightforward exercise, I wrote my blueprint for the Cinder project because Cinder is responsible for block storage at OpenStack and that is what interests me most, at least for now, but the task required writing skills that I have not really developed. I am still struggling with my writing skills. So, it took me a long time to write the summary of the blueprint."
Teaching by Demonstra- tion	Mentors within the SECO is well vast with knowledge in multiple domains and teaches participants not only the theoreti-	M_7 : "We will demonstrate the benefits in splitting up changes into a sequence of individual commits, and the importance in writing good commit messages to go along with them."
	cal component of the training program but also the work; do as I do not only as I say principle.	M_7 : "I will show a live demo on how to use a storyboard, the different tabs and widgets that you will use in this exercise, and how storyboard works in general."
		OB1: "(M1) walk through all the steps and explain to the participants what happens at each stage."
		Continue on the next page.

Code(s)	TABLE II – Continuation	Examples
Ice breaker and Breakout session (Niche creation)	During the OUI training program, participants were arranged in clusters of 10 groups and mentors encourage team work and competitions among these groups.	<i>OB</i> 1: "P33 and P35 seated on table/group 10, were exchanging ideas constantly throughout this exercise 1, therefore, OB1 moved to table 10 and asked both P33 and P35 how they found the exercise and if they could walk him through the steps that they took in doing the exercise."
		<i>OB</i> 1: "participants within each group were sharing information to help solve their problems and also using the IRC common channel to share their ideas or ask questions from other participants outside their group/table."
		<i>OB</i> 1: "P44 asked a question to P40 how to assign the bug on launchpad, and P40 showed P44 the steps to accomplish that task. Moreover, similar kinds of collaboration were happening across the different groups/tables among participants."
		M_{12} : "create and register a blueprint against the sandbox repository. Include a description and assign yourself." Specify the Name, Title, and description of what the blueprint should accomplish."
Question/Answe Sessions	rThroughout the OUI training program, mentors organised the sessions to be in- teractive to support questions and answers	M_{31} : "answer the question that M5 asked that to modify a patch within a chain you will need to use interactive rebase $gitrebase-iHEAD$."
		M_6 : "Can I deploy DevStack to the cloud? Since it pulls all OpenStack services."
		M_2 : "Ask the students questions to make sure they are engaged and understand the material."
		TESTIMONY1: "first question I always ask when someone expresses interest in working with OpenStack helm is what interest and excites you I asked this question because I found that there's if there's no interest or excitement for the work you're looking to do it often leads to frustration."
		M_1 : "Use IRC for answering questions or the training etherpad if an exercise requires more space."
Adaptive Teaching strategies	Mentors in the OUI program use different teaching strategists to teach participants.	TESTIMONY1 : "People learn in different ways at different speeds which means a commitment to active mentoring requires more than a handful of quick IRC or Google hangout Chats when our time constraints increase and we start wishing we had 25 hours on a given day to get everything done that we need to."
		TASK1: " Problem-based learning helping students to find solutions for the problem themselves."
		M_1 : "We wanted to lower the entry barriers that new contributors were having – speaking from experience, we discussed among ourselves and put down several points that can be beneficial for new contributors." M_2 : "Be prepared with the "deep dives" exercise; usually, participants have very different levels of knowledge and skillset."
		Continue on the next page.

Codo(s)	Description	on from the previous page.
Code(s) Testimonies	_	Examples TESTIMONY1: "So far, we've given you some perspec-
from Mentors	Mentors who were once menttees usually come and give live testimony to encourage new menttee on their journey towards becoming successful contributors	tive on our experiences with OpenStack to date we're going to get to the juicy parts and why we feel mentoring upstream is important which is I assume why you're here."
		TESTIMONY1: "So, as a new developer fresh out of college coming into any new team can be very intimidating"
		TESTIMONY1: "So, I'll talk a little bit about my experience when it comes to mentoring upstream after reflecting on my experience with previously you know the OpenStack community and now the open infrastructure community over the past."
Vast expertise needed SECO	From the SECO perspective, contributors/participants need to have vast expertise collectively to drive the SECO forward. This brings enormous benefits to the	TESTIMONY1: "Ultimately the technical expertise required to work with the technologies that make up the projects under the open infrastructure umbrella it can be pretty vast that technical expertise."
	SECO.	M_1 : "Each mentor takes their rounds and introduced themselves, their area of expertise, how many projects they are affiliated to and how long they have been contributing to the OpenStack ecosystem."
		TESTIMONY3: "I've noticed it's easy to overlook the differences and the technical proficiency between myself and someone I'm working to mentor."
		TESTIMONY 4: "Concerning upstream mentoring, differences and technical proficiency should be taken into account when mentoring in the workplace"
		M7: "stated that: "Based on many years of practical experiences doing code development, bug troubleshooting and code review across OpenStack projects and other communities such as Linux kernel, CoreUtils, GNULIB, etc."
Lack of self motivation/	SECO may face challenges filling in the gap for participants. OUI program encour-	M_7 : "Intensive program designed for newly graduated student in mind who are motivated and about to start their carrier."
commitment	ages participants to be self motivated.	TESTIMONY4: "Successful mentoring relies on active commitment from both parties and I've always been enthusiastic and willing to help anyone who's approached me directly about mentoring because it shows me they take initiative and not only succeeding in their day to day job but they want to actively manage their expectations for their long-term career goal."
		TESTIMONY3: "I've also found successful mentoring requires active commitment both from the mentor and mentee. It's very easy to say yeah sure I'd love to help you understand all this cool stuff."
		Continue on the next page.

Code(s)	Description	on from the previous page. Examples
Productive mentors-	Expert-Novice collaboration; the OUI program encourages participants to make	TESTIMONY1: "in particular, my engagement and contributions accelerated rapidly from that point."
mentees collaboration	their first commits accepted within a reasonable time and to regularly sub, it patch sets following best practices that SECO encourages. Also, mentors facilitates mentees to stay active while con-	M_7 : "After the 2-Days onboarding event, participants can sign up for a longer-term mentoring program to further strengthen their skills and become more productive and successful in the community. — That's the way to transform learners into practitioners."
	tributing to the SECO.	TASK3: "Make sure you work with mentors to get this right and we move on to the next activity. Mentors collaborated with the 51 participants and get the body text to match the limit of 72."
		M_6 : "approached P39 and asked if they need some help summarizing their text to give meaning to the changes made? P39 affirms needing help and both M6 and P39 worked together to write and acceptable summarized text."
Productive mentees-	Novice-Novice collaboration, we observed that participants were actively collaborat-	P_{46} :" Meanwhile P43 and P47 submitted 65 and 87 characters respectively on the IRC channel."
mentees collaboration	ing among themselves without the help from mentors to solve problem. This type of collaboration was rampant.	OB1: "moves to group 11/T11, and observe participants P61 - P66. Members of this group were collaborating and exchanging ideas among themselves, but each member created their task independently." OB1: "Noticed that all 12 group participants were paired 2-by-2 to work on this exercises P1 post a comment on P2 bug and P2 post a comment on P1 and the rest in the group P37 post comment on P38, P38 post comment on P39, P41-42, and P42 post a comment on P37, etc and on the blueprint, they reversed the order."
Mentorship sustainability A large distributed SECO with an onboarding program can run the risk if companies and dedicated team members are not participating to training new members to become experts.	TESTIMONY3 : "M7 was my mentor during my last year of college and I have been very fortunate working with them and to continue being their mentee."	
		M_1 : "This year, Lenovo is sponsoring the onboarding event. But the Onboarding is organized and run by people embedded in the community, opportunity to ask experienced contributors questions and gain more insight into their work with Open-Stack."
		M_1 : "We have seen some PTLs coming back to OUI training for some kings of reality checks."
Cross-project dependencies	There are various projects within a SECO, however, some projects are interdependent to other projects, which the SECO refers to as cross-project teams, by definition, they have dependencies among themselves.	M_12 : "cross-project work in an ecosystem setting, in which each project is different in the process of reporting bugs and planning new features, for example, a story could be to invent some new feature A, and tasks would be changed in project X, change in project Y, and change in project Z. Those changes need to merge in order to complete feature A."
		Continue on the next page.

Code(s)	Description	on from the previous page. Examples
Investment in mentoring creates Job opportunities	Companies are hiring participants from the OUI program as such, the SECO is calling for more sponsorship.	M_12 : "Investment in mentoring is key to staying competitive and keeping employees happy so in the long run yes mentoring can be an investment on behalf of you know the company but it pays out dividends later on."
		M_7 : "an investment and it's it brings you business value and it helps retain talent because it keeps people happy and it increases skills that are hard to find in the marketplace."
Mentoring Enhances Collaboration	Some tasks in the SECO, especially the cross project task are complex, hence calls for collaboration with divide and conquer	OB1: "the aim of this section is to introduce participants on collaboration, how to work in a team project using divide and conquer technique."
to solve complex problems	technique.	OB1: "participants divided their task into three groups, One group ran one test suit and the group shared their knowledge and explain how all the test cases fit together." OB1: "Group members spend much time deliberating on their approach and solution than implementing the solution."
Mentoring Mitigates Impostor	The feedback and testimonies from Mentors help to prepare participants on how the real world looks like. Especially how	TESTIMONY3 : So, the maturation of those technical skills may also help alleviate impostor syndrome as most of us are likely familiar with.
Syndrome Effect	they have overcome the imposter syndrome.	TESTIMONY2: "as a new developer fresh out of college coming into any new team can be very intimidating. Everyone around the kind of knows so much more than you and you feel that you're an imposter with so much to learn."
Enhances Diversity/ Inclusion terms of gender, technical, and corporate for example, OpenStack strongly discussion ages one company from having a majinfluence over the SECO stakes of a	OUI program encourages diversity in terms of gender, technical, and corporate. For example, OpenStack strongly discourages one company from having a majority influence over the SECO stakes of affairs but welcomes openness and collaboration,	TESTIMONY2 : "By expanding that diversity we're able to expand ultimately the diversity of opinions for the open infrastructure project as a whole with the goal of as soon as we start at least, in my opinion, is we grow the diverse opinions that we have it should hopefully start to attract additional individual contributors as our solutions expand to cover more use cases."
	and fairness in diversity and inclusion	TESTIMONY2: "if we grow the diverse opinions that we have it should hopefully start to attract additional individual contributors as our solutions expand to cover more use cases"
		TESTIMONY2 : "infrastructure community and the individual projects that make up this diverse infrastructure ecosystem."
		M_{12} : "projects, or sponsors may create a board with manual or automatic lanes to provide a clear overview of the activity of interest."