**Theme 1: Technical Debt Identification**

1. Participant 2's experience in developing software prototypes involves several stages,

* Stages include gathering requirements, designing, implementing, and deploying.
* Challenges related to tools, standards, frameworks, programming languages, and conventions have been encountered, particularly in integrating data sets and managing errors when working on the project.

2. Participant 2

* becomes aware of technical debt through teamwork and collaboration.
* They gather as a team to discuss challenges and errors in the implementation phase, conducting further research to identify and address technical gaps.

3. Indicators or red flags that signal the presence of technical debt in Participant 2's project include the complexity of incorporating data sets from different regions, which can lead to challenges and errors in the project.

**Theme 2: Technical Debt Measurement**

7. Participant 2

* Prefers to measure technical gaps, especially during implementation, by collectively identifying errors and challenges within the team.
* They discuss issues and research solutions together.

8. Currently, Participant 2

* does not use specific technical tools for measuring technical debt.
* However, they acknowledge the potential benefits of tools like SonarQube or Step Size for this purpose.

9. When prioritising technical gaps for resolution, Participant 2

* believes that addressing issues during the implementation phase is crucial since problems tend to accumulate and become more complex if left unaddressed.

Theme 3: Technical Debt Impact Evaluation

10. Unresolved software gaps, according to Participant 2,

* can significantly affect the quality attributes of the software prototype, such as reliability and performance.
* If certain sections of the application do not work correctly, it can lead to unreliable outcomes.

11. Participant 2 shared an example of how technical gaps may affect the project.

* They mentioned challenges with incorporating data sets from different regions, which can lead to the system not functioning correctly for specific data inputs.

**Theme 4: Early Debt Repayment**

12. Regarding practices or strategies to encourage early repayment of technical debt, Participant 2

* noted that their curriculum and department do not currently have such mechanisms in place.
* However, they mentioned a colleague who received recognition and awards for quality work, suggesting that success can serve as a motivating factor.

13. In terms of incentives or mechanisms to motivate the team to manage and reduce technical gaps, Participant 2

* highlighted the need for guidance and support from supervisors or the curriculum.
* They emphasised the importance of having a framework that guides students in managing technical debt during project development.

**Insights:**

Participant 2

* Emphasised the importance of nurturing students' ideas and promoting their implementation in software prototype development.
* They also expressed support for the implementation of a framework with guidelines to assist students in managing their projects effectively and reducing technical issues.

FULL TRANSCRIPT

# **Mooli Brian Comp Science**

So I will start by maybe introducing myself. I'm doing software engineering in year 2.So basically I'm doing research looking at software architecture.

In this research I'm looking at internal qualities of the software. So in this I'm looking at young teams, young teams, how they develop their software, the processes they go through, and then the tools that are available to enable them to develop the quality software and identify the loopholes that they can always fix.

So that's the research I'm working on. The main objective is to collect the metrics that enable you to identify technical gaps. By technical gaps I mean technical debt is defined as the consequences, the long term effects that your software will suffer or you as an individual will incur when you take shortcuts or some optimal solutions.

Let me say you have quick fixes and you say let me get this solution, let me get this product working, I will fix these things later. By the time you talk about later, let me say one month, two months, when you get back to the software you can't really tell what you were meaning by a class or let me say a logic that you implemented.

So that's a technical debt. The time you are taking to think about what you did or what you will do to solve that problem, that time there is already a technical debt. technical debt is compared to financial debt. In a financial debt when you borrow from the bank, by all means you have to pay.

There is always a cost because when the data accumulates you pay, you incur more interest. So that's why I say this technical debt, this interest is incurred in terms of maybe resources, maybe time that would have been used to do other things or other productive stuff.

You are thinking about something that you would have solved already. So that's a technical debt. So I think we will start by telling you your name, your course and then the project you are working on and then your law project.

Thank you very much. My name is Moli Brian. I am a student of Bachelor of Science in Computer Science. In my year 3, my final year, I am currently working on a final year project. This is a crop growth recommendation project which is having machine learning and efficient reagents.

This project is responsible for determining which crop is supposed to be grown in a specific period of time, following aspects of weather, that is rainfall and temperature and also looks at the soil types. So this crop is able to predict that in the near future, I say in the next two months, it shall have this amount of rainfall

and to recommend which type of crop is supposed to be grown by the farmers. Then according to the soil types of the place and all the region, it can also recommend which crops are suitable to be grown that can be favoured by the specific soil types. This project also recommends the activities that could be done during the growth of the crop

because according to the crop that has been grown, different activities can be carried out in specific times. So this project is able to tell what type of activities are supposed to be done. Maybe let's say that the amount of rainfall that is going to be received in the next two months can support the crop up to a certain level of growth.

Then maybe it can recommend irrigation such that there can be continuous production of crops throughout the year. Since Uganda is a country, mostly it depends on agriculture as its economic activity. So we look at a factor that can help improve the major economic activity of the country, that is agriculture and crop production.

So basically you're looking at embedding AI in agriculture. So what's your role in the project itself? My role in the project, I am the project coordinator, the project programmer, in charge of the programming and identification of what is supposed to be done to make sure that the project really comes out with its implementation as expected.

So you're working, is it a web application, IoT, mobile app? We are doing everything as a web application such that anybody who can access the web can use it. That's good. You talked about your project, what are the objectives that you want to achieve and the requirements that you need for the project?

Our objective is to make sure that we link up, the objective of the project is to link up with all the farmers, especially those who are producing crops on large production for export, for sale, to make sure that they have, they reduce on the losses they always make.

For example, when you look at different places, we have had farmers who have made losses because they were not aware of what is likely to happen in the near future. The farmer grows a crop and then in the near future there is heavy rainfall and there is flooding and there is a massive destruction of crops.

So the losses become many, which affects the produce of the crop on the world market and also on the regional market. It also affects the production of crops, the production of food supply in the country, which can also affect the aspects of famine and bring in aspects of famine and prolonged suffering among the people.

Then we also look at increasing the amount, the income of the farmers, now that the country, the farmers are depending on what they are producing, if they can reduce, minimise these losses, then they can increase their income. If the farmers can determine what activity is supposed to be done in a specific time, it can increase production throughout the year.

Not that farmers are supposed to wait for the next season for the crop, but if they can understand what the other aspects will be in the near future, then they can switch to which crop should be grown before the next season, because we have recommended activities that can enable them to proceed with farming and crop production throughout the year.

So you identify the requirements that you are going to use for the project? The requirements we are supposed to use are the aspects of the variations in weather, that is through getting the data sets, data sets that are supposed to have weather variations, that is in rainfall, temperature. Then also collecting data sets about the soil types in a specific region, let's say we are concentrating on the Masaka region, where there is a good amount of crop production, so we identify the soil types that exist in different regions of Masaka, and then connect them to the crop types that are always grown in the place to see how best those soil types can support the crop, and how the weather conditions can support the crops, and determine what amount of rainfall, what temperature is suitable for specific crops that are always grown in that place, and also that we can recommend when they are supposed to be grown. So you have also looked at, because I believe there are different projects that have been implemented in that way, have you looked at the way of incorporating them in your work, or making them better using your prototype?

Yeah, the projects we have come across, we have come across projects that have only concentrated on soil types, and within these projects it is possible that the soil types, the types of the soil, they rarely change, because if you look at soil pH, its variations are very, very, very small, but if you look at aspects of weather, weather conditions will keep on changing.

So focusing on looking at the similar project that we are looking at, weather, and that we are looking at for soil type, we thought it wise to incorporate it with weather, so that since weather is a bigger condition that is affecting crop growth, then putting in weather, aspects of weather, that is rainfall and temperature, would be a better way to improve on that project that is already existing.

Alright, that's nice, that sounds like a great project to work on. So in this project that you are working on, what are the technologies, the languages, the frameworks, libraries you guys have used when you are working on the prototype?

The languages we are using, programming languages, we are using Python, Python programming language, then we are also using the ACSS HTML, we have the HTML here, then we are also looking at using the Django frameworks, we are using the Django frameworks for the web app, we are using the Django frameworks to incorporate and then have the web application developed. So what are those challenges that you guys have so far met, those technologies that you want to use for your project?

The challenge is, one of the challenges we have first, before the technologies anyway, we have been working on this project throughout the semester, so you know while you are studying and developing a project, there is that balance of time, you are having tests, you are doing course works, and you are fixing deadlines for submission of the progress, you need to know how you have progressed, so sometimes we face a challenge of time management and the time balancing between the design of the project and the academics, then when it comes to the technologies, sometimes you find out that when you encounter bugs or errors in the implementation or in the design of the program, some errors get, like depending on the type of software that has been installed on a specific machine, or when you are using a operating system, some of us are using a different operating system, it's now become difficult to identify what error has been used, has been determined by a colleague who is using a different operating system and yet you are supposed to have progress, match the section he is doing and the section you are doing, have it run as a single program.

So because I believe that now that is a documentation or communication, then that one becomes also a technical gap, so what do you normally use to identify these technical gaps in your development phase or let me say that life cycle, how do you identify that this could be a problem in our prototype? Identifying a problem, one, we sit down as a team, when someone is developing a specific, let's say someone is working on a specific data set, and they are working on a section of the project and the other person is also working on the other project, where the colleague encounters a challenge, we come down, we come together as a team, sit and then discuss, and when we discuss, we do more research, we discover that, we discover now the specific area that a colleague has faced a challenge in, then we first solve that as a team, then we can go back and proceed with our individual tasks. That's wonderful. So what are those indicators or red flags that you may look at and believe that this is a problem in our, let me say it is a compromise in our project, like a red flag, let me say a long way, like you said, you have to balance between books, course works, and then the deadlines, and then the work on the project, so by the time you go back to the project, what are the red flags that indicate that really we are ending up, we may end up not having a quality product or we may end up having a product that may be too hard to be implemented in the future, so what are those red flags that you may identify? Red flags? What are the indicators? One is that our project seems a bit baroque, because it has very many data sets that are supposed to be used, you have to incorporate the data sets for the weather, just having temperature, having data sets for rainfall, you have to incorporate data sets for the soil types, you also have to incorporate data sets for the crops, what is the suitable, what conditions are suitable for those specific crops, so it seems a bit baroque, so incorporating these data sets and matching them to present one recommendation is something that seems hard,

because all of them have to collide, have to match to present something that can recommend, that can give a conclusion, that can draw a conclusion about, so the red flags we keep meeting is sometimes failure to incorporate the data sets you are getting from different aspects of the conditions that we are considering to develop the system.

Okay, so when we look at the side of measuring those, let me say, the red flags or the bugs you have identified, how would you like to measure those bugs that you want to fix in the project itself before they become dangerous for the system,

how would you like to measure them or quantify them? Now, that is something we have kept on thinking about, that if possible, if we find possibly a site or a software, where we can enter what we have gathered and where we have recorded our error,

and it's supposed to reveal what type of error that has been encountered and possibly how it can be solved, that would be something better, so if we could find something like a software of that type, where we could put our code, put in our implementation and identify the error that we have

and then recommend on how we could go about the error, then that would be something better, help us push it on our project and have it done in time. Yeah, so that takes me to another question that says, currently which tools do you normally use, maybe to identify or quantify the bugs or the errors or the compromises that you have in your project, something like that?

Currently we are using Stack Overflow. You are using Stack Overflow and… Basically I mean like the tools, let me say like you are developing a software, let me say like now like in Django, maybe you are using an IDE and you are like,

this IDE is an extension that you are using maybe to identify the bugs or to identify something like that? Currently we don't have any that we are using, we just strive to make sure we identify what the right is and… So you go the manual way?

You read the manual way, you are going, reading the hardware. So like in software development, you know like when you are identifying these bugs, there is always, you can't identify them at a go, so there is always requirements, there is when you are gathering the requirements, after gathering you analyse, then there is implementation, design, testing, deployment, so in all those phases, where would you like to have the where would you like to prioritise the technical gaps mostly? Mostly, technical gaps are always identified mostly in the implementation because when you gather, you may gather information, you may gather the requirements, you may do everything and then you really look at what you have, and something that is going to give you a very good and wonderful project, especially when it's implemented. But now challenges come in, gaps come in when you are not doing the actual implementation. Sometimes you come up, you may reach somewhere and find out that your implementation is forcing you to go into a direction where your intention wasn't, or a direction where you didn't intend to go. Just because you failed to meet the exact target, you now decide to deviate to a certain direction, to have things possible. So the gap is so much in the implementation. So that's where you would like to prioritise most, like when you get a tool that enables you to identify these technical gaps, you would like mostly in the implementation. In the implementation of the project, yes. So how does these unresolved, because you talked about the bugs, how do they affect the structure of your project, let me say in terms of, the white attributes of your software, like performance, reliability, and then the middle grade of your application? For the application to work normally, and to work promptly,it means that all the tools that have been put in the application, all the areas that are supposed to handle issues in the application must be functioning. But if there are bugs, it means that there are some sections of the application that will not function. So maybe if there is a section that is supposed to, giving reference to our project, if there is a section in our project that is supposed to give a notification about the coordination between a specific type and maybe a specific crop, maybe this crop, the rainfall is stable for this crop, but the temperature is not stable for the crop. If there is a section that is supposed to maybe give a notification about that, it is very, very important that information comes out, that the farmer can be able to tell that if I grow this crop, the temperature is okay, but the rainfall is not enough. So if the temperature is fine, but I can handle the issue of rainfall, I can maybe do the irrigation, according to the amount of rain that is going to be received. So if that section does not work, then it means our implementation is not up to standard as expected, because we expect it to give the best results. Be reliable? Yes, that's how it can be reliable. If it can't give the exact expectation, then it can't be a reliable project. That one, actually, brings me to another question that says,in your project of incorporating AI into agriculture, can you identify any example of a technical gap that you really see that is a technical debt in our system that will affect them? You may have used a solution that worked for you and the project worked, but then you believe in the long run, let me say, after two months or three months, it will become too hard for you again to implement the same solution.Now the technical gap, the gap that we think maybe, some extent, may not work out, is when we use data sets for a specific region and the system works. Then comes the time that we want to use data sets from another region,and the system may fail to work. That's where the gap that we can really have. If our system cannot work for different data sets, data inputs from different regions, then that's where the gap could be, possibly after some time.That's nice. I've now realised that maybe some of the things that we should be incorporated into the framework, let me say, during the testing, the application. Are there any practices or strategies in place to encourage,now we talked about the payment, we talked about the bugs in the software. Are there any strategies or practices that, let me say, the supervisor or the university or the curriculum encourages you to do that enables you to pay, when you identify these technical gaps in your time, are there any strategies that enable you to pay them in time? Currently, the curriculum doesn't have any,neither does the department of computer science have any that recommends that when you identify this bug, you can pay. All I know is that they can just give you guidance on how you can go about the bug.Then if it becomes something that is difficult to handle, they can recommend to possibly do something else, replace it with something else that can be feasible. Or if the system now, like the project, the software,they can ask to ignore that part of the project, then do the parts that are feasible, that can be possible, that can reach the final implementation. So that means, because I was going to ask you, are there any other, let me say, rewards that you feel you gain after you,

let me say, paying that, let me say, you have a bug in your URLs, like in Django, let me say you identify maybe the URL names you've given them, they might conflict in the future, but because the project is very small,

you decide to go with that naming conversion. By the time you reach, when the project has grown big, you realise you would have done that earlier, you would have paid off, saved your time, something like that. So that's what I'm talking about, let me say.Maybe you are like, let's implement security without our security department, in each phase of our department, make sure that we reference security somewhere. But then you realise that you never did that, that becomes a cost for your side.

So I'm asking, are there any rewards you feel like in your project you've gained, or let me say from supervisors or from management of the university, that you feel rewarded when you have approached them, that is, let me say, not 100% free of the bugs, but at least they are minimal.

Or have you ever had your friends that have quality products, that you appreciated that their product is serving less bugs, or is taking backups, something like that? The rewards I have had are, I know of a colleague,

who let's say, he just graduated last year, he designed a project and his project was a deaf-use bag, it's a bag that deaf would use, and the deaf line,

and it would allow that person with a disability to do things without any help. So to some extent, his project was so much productive, and he got funding, got support, and he showcased it at the international level,

and he won some good awards, it was a reward because the university promoted his project, and he was having something that was very good, his implementation was so good, it captured international attention.

So in addition to that, are there insights or things that you believe can be included in such a framework that is designed for students to help them have a prototype

or software projects that have less technical gaps or technical lessons in them? Yeah, there is need, because students always have ideas, and they have brilliant ideas, and these ideas are always good,

if someone's idea reaches its destination, it can come to completion. So students always have that very good passion, if their ideas can be promoted, can be protected, they can be amplified to make sure that they are guided,

to make sure they have their ideas implemented. So if that site can be there to develop this prototype for the students, it's always something that I can buy, and I also recommend it, it's really necessary to have students' ideas implemented.

Maybe on the other side, about that, do you normally use tools, let's say technical tools to identify, oh I remember you saying you don't use,

you have an idea of them, but tools like sonar cubes, tools like step size, this helps you to identify technical gaps in your prototype, you don't use them? We haven't used any of them yet.

So is it because maybe you were never introduced to them by a supervisor or a management, something like that? I'm sorry to be that. So do you believe a framework with guidelines that enables students to have,

let me say from the start when they are developing their prototypes, to have this included in a curriculum of their projects, or final year students, they have these guidelines with them, that at the start of the project or in the middle of the project, at the end of the project they have the baseline to quantify their product,

their prototype, do you believe that such a framework can help them? Yes, it's really necessary because if this framework were in place, and maybe during the time of the project, the lecture of the project, the supervisors can meet the students and give them information about them,

such that there is a schematic flow in the design of their projects, because their projects can be done faster in time, because they have to balance their books and the project, so this can also help them do things in time,

it also minimises bugs and technical issues that take much of the time of the students, identifying and these bugs that can, sometimes some students get so much stressed when deadlines, they come with deadlines and their prototypes,

their projects are not getting the information, so if we can have these frameworks introduced to them as early as possible, then they have a sense of direction on how they are supposed to reach. Thank you so much, that was so insightful, I really think I've taken that one,

because we know with a prototype, we don't know where it will land, if you have a prototype, after two months you are pitching, maybe your idea was so nice and you are pitching the idea, then they tell you maybe in one month you implement this,

you scrap off this login, implement the login like this, but you really can't even implement the login, because you use the shortcuts, you use the suboptimal solutions, that you yourself cannot even recall what you are meaning, so it goes back to the other side of the documentation,

maybe you never put enough documentation in the system, so if we have such a framework, it is really helpful for students, and then the supervisors themselves, I really believe after collecting this data, and then developing the framework, I will contact you,

because you really need to get it, if such a framework can really enable students to have prototypes that they can be proud of, prototypes they can implement after some good time, or after some years, or that can get funding from the would-be

So thank you so much for your time and participating in this event. You are welcome, it has been a great moment, and I hope to put it to know more about FACTSAVE. Thank you so much, I'm so grateful.