

## Focus Group session transcription

### **Q1.1 - Which approaches do you know for the selection of Constituent Systems when conceiving a SoS?**

**[P1]:** Concerning this question, uh, while I was listening to what Vania was saying during the video, it seems that there are some analogies with the configuration management and software product lines. So, especially in the software product lines where you define the number of features of your systems, and then, uhm, essentially when you want to create a product, you select the features, or fix the variance that you might want to have for your final system. And also you have also some analogy with service-based systems or with the choreography and orchestration in general. So I don't have a specific approach, that can fit in this particular uh, um, setting, the one that you're proposing. But, again, I can comment or I can suggest to have a look at what in the software product line people have done, because it seems that there are some analogy uh, um, with this research field.

**[P5]:** Um, I mean, If I'm thinking as a developer, uh, the first thing I will do is to give a look at existing systems in GitHub, that might be reused for building my own system of systems. Use GitHub as some kind of a catalog of systems that have been already implemented by other people. And then maybe I had the chance to reuse some of them as constituent systems.

**[P3]:** If we're considering that a system of system must be created based on a goal or on a mission, eh, we need to consider the project goal for why we need a system of system. what is the necessity of that system? So, um, I've worked in two different scenarios. One when there are the constituent systems, for instance, in a hospital, they have different constituent systems already used. So they need some kind of integration of that systems to obtain some acknowledge or obtain some goal. So the constituent system are already there. So, I don't need to look for them. So as an architect, um, I need to know or create some strategy to integrate them to achieve the goals but we need to know the goals of the system. Okay. Like on any other project and the other one. Okay. Uh, On the other one we need to create a system, we know the goal, but we don't have knowledge about which systems we need to create or to look for. When we are working on novelty system of systems, in most occasions eh, eh, we need to create the constituent systems also. So, I don't know really how to look for constituent system in this questioning. Or they are already there or maybe we need to create some of that constituents.

**[P6]:** Yes. Uh, well, Two years ago I was working on something, uh, using optimization because, you know, as Vania has explained, when we want to build a system of systems the intention is to gather the constituent systems that could offer all the functionalities needed to construct the behavior. So, uh, I am aware of this work here. I'm putting it in the chat, is the work from research page. He uses genetic algorithms to run an optimization on systems that could be acquired to build a system of system. So the idea is using optimization to reduce the number of systems and maximize the number of functionalities you need to draw, uh, an emergent behavior.

**[P4]:** Okay. Nice. Okay. And last, also very good input. So the next you, yeah. So, I wanted to say that what [P1] was proposing to look into product lines maybe, uh, it is a good idea. And also since you're talking about the features of the system, you should look for feature models because I see a lot of analogies with, for example, if you look online for car configurators, you can find a lot of fancy tools in which you can select the features you want to add to your car, and then you will get in output the configuration.

**[P1]:** Uh, just, uh, uh, it is not clear to me if you're also considering the time. So in sense that if your selection happens at the design time or also can change at runtime. So, because in this case, there is a spectra over, you know, self adaptive systems and where you have some monitoring that will analyze the context. And there is some change in the context that it might happen, than there are some constituent systems that need to be replaced or changed.

**[P2]:** Okay. Uh, yes, I just wanted to connect with what [P3] was saying. And since you were suggesting methods, uh, to look into, there are also methods around goal modeling and especially the KAOS approach that may be suitable for this type of context. It is not for the selection of the optimal configuration, but more for the modeling of the different goals of the systems.

## **Q1.2 How important/challenging is to manage variability during SoS modelling/design?**

**[P4]:** Um, since I'm not sure, but I think the problem is the size of the model you are managing, of course, if you're talking about variability, if you have a lot of variants, it can be very important for the representation and also for the selection.

**[P1]:** Related to what [P4] is saying. I think that it is also difficult to model each constituent system. So it's like, I mean, let's say the concept of abstraction and the completeness of the description that you have for your system. Because depending on what's your model, then you can take some decisions. So let's put it in terms of granularity. And this is a challenge you may have here, especially when you don't know completely the constituent systems that you want to include, that you would like to include. Image that you are retrieving some assistance from some existing system, and you would like to include it in your SOS. Then the granularity of the knowledge that you have can be an issue.

**[P2]:** Yeah, Connected to what [P1] was saying, even if you know everything about all of these systems, you may uh, not have control on those systems. So they may evolve independently. And so you need to add some capability to handle variability, but variability also under evolution of the single systems and some way of interacting with even the owners of the single system. So it's not just managing the components and the variable components, but managing the stakeholders who own the components or have some interest.

**[P3]:** I agree with [P2] and [P1] comments. I also wanted, uhm, to add that, eh, eh, you need to suppose that all constituents have a standardized interface or something, or the

interoperability of them can be achieved before they can be modeled or integrated. Because this is another important point of variability, it is how the constituent systems share their information, which interfaces they make available for connection. So this is an important point that you need to consider in this variability, because that could change, or maybe the constituents that are done, if they already exist, maybe they don't have this facility of interconnection.

**[P6]:** Well, I, I agree with, uh, eh, eh, all their contributions until now in this topic. Only to complement, I don't know if someone put in those terms, but, systems of systems in general have dynamic or evolutionary architectures. This happens because the CS can come and go, can join and leave the SoS at runtime. And so this is a challenge to manage variability because the variability is not always available for the system of system. So, I don't know if I am using the right term, what I mean is something that is variable between the constituents in some point at time, can do out of the SoS, because the constituents leave the SoS. So it's necessary to manage the presence of all the necessary functions or capabilities at runtime. And this is, I think it's a kind of challenge.

**[P5]:** I agree with [P1] and [P4] responses.

**[P3]:** Eh, just something that I, I remember now, um, constituent systems can go and entering in the system of systems. The mission also can change over time. Eh, So the mission could be variable. So depending on the missions, you need to consider all their constituents systems to decouple some systems that are already integrated. The same system of system needs to disconnect to join system for a specific, a mission. So mission will also orient the set of constituents systems and functionalities, and must be integrated of, oh yeah, in certain time of the operation of the system of system.

**Q1.2a: Which approaches do you know that could be used or adapted?**

**Q1.2b: As far as you know, could PL approaches be used/adapted?**

**[P6]:** Yes. Uh, well, since I said that, uh, dynamic architecture and the presence of constituents can be a challenge to manage variability in systems of systems. So, I put this article in the chat. This is something we have invested over the past years to simulate the evolutionary architecture at design time. So, um, maybe it could be used or adapted to exercise the different coalitions, the different as you say SoS variants the SoS can assume, uh, at runtime or could assume at runtime and we could predict and manage that.

**[P2]:** Since uh, you're asking about approaches with the product lines and for variability management, probably the ones that could be applicable here are those around feature models synthesis, based on requirements or textually input for example. There are cases in which you collect a feature description from the market or recommended systems, and you try to synthesize a feature model of what is available in the market for a specific purpose. So these are approaches around feature model synthesis. They use this feature models that are ways for representing variability and uh, with, uh, adjust trees with the different features

and these approaches take natural language input in the form of requirements or feature description, and try to generate a future model.

**[P1]:** Oh yeah. If I can comment. I mean, I agree with [P2].uh, if, uh, we, I mean, I would also suggest to have a look at all the fields related to feature engineering because it is also difficult to identify or to define what a feature of the system is, because essentially we want to identify some reusable paths and some reusable features. And then, there is again this problem of granularity about what the feature is. So the result is a feature engineering topic, which is quite, uh, extensive topic that you can have a look at if you have not done so already.

**[P4]:** Yeah, no. Um, I looking at these questions, I have kind of doubt, um, I guess, um, I see that I think you can represent these things with product lines, but it also depends on what let's say you attach to a configuration or to include in a configuration because you are saying that constituents can join or leave the system of systems. So, I was wondering what would be the condition in this case. Because in this case, you will have multiple snapshots of the same product line, but with different conditions. So it's like having a versioning of product lines maybe. They are very similar one to another, but with different conditions. So this would add, I guess, next, um, um, I don't know how to say, um, it will, it will make the product line more complicated, I guess, in the representation or complex.

## **Q2.1: Please comment usefulness/issues of Vantess with regard to handling SoS variability**

**[P1]:** Um, so when you are defining your, uh, your approach, I think that you have look at what exists out there. No? let me see. Existing techniques that might be useful for managing the SoS variability. And now it is not clear to me, uh, again, what, what are the strengths, the strong points of these Vantess with the respect to, yeah, variability management of a use case modeling for instance, or modeling variability in, um, with the, the language that we already have. Um, so again, this is, uh, maybe this is my fault. Didn't manage to get these properly, but still, I mean, I, I think that the, of course the, the, this is the problem is a, is a challenging, is, uh, uh, interesting. And, uh, we needed to have some tool like this, but I don't see again, the strong point with respect to what already exists. Um, in the project management, uh, um, let's say area. Feature modeling, project management, uh, uh, uh, and also related to requirement management, as I was saying before.

**[P1]:** I am not saying that it is not novel because ,I mean, in 10 minutes you cannot get to know all the..the strong point of this, of the, of the work. So, um, I, again, I, uh, I don't see distinguishing elements with what exists in variability management, because at the end, again, we were talking about, uh, issues related to, um, uh, okay. Um, eliciting, or you can define the cost of the elements at design time or at runtime. So there are a number of challenges, right?

So at the end, you are, um, proposing, uh, a design time approach. So essentially you specify, um, what are the, uh, the functionalities that you would like to have in your system of systems, and then you try to pick systems that satisfy your requirement, or what... what you'd like to have, um, and, and again, there are many challenges in the, in, even in what I'm saying and what you are saying. Uh, but I don't see, I've not seen in, in the presentation, since you have many challenges, which one you are able to, uh, address, uh, better than the others. So, because again, there are many challenges and the thing that you should have focused on, or the main one... that you wanted to address properly, and with the new approach, with the novel way.

**[P2]:** Yeah. To add one thing, uh, that one main issue that I see is, uh, uh, related to the cost. And, uh, you associate the cost to the single component. While in this context, that is systems of systems, you have a cost also related to the compatibility of the components. That is the most relevant one, I would say, in this system of systems, because if you have a very strong choice, but it's not compatible with all the other, and you cannot integrate with the rest of the components, then you are stuck. The cost is maximum, and you cannot say, you cannot select that specific component. So the thing that I see is missing, uh, from what I understood as the main difference between a system of system and a system that I developed in my company, and I can, uh, combine in the way that I want, and I can transform in the way that I want... is the issue of compatibility of the components and how to make them interact. And I don't see this cost being evaluated in your approach.

**[P5]:** yes, I agree with both [P1] and [P2]'s points. Um, maybe the last point I was, the [P2] was mentioning, might be a distinguishing factor with respect to the state of the art, as far as I know. So integrating, uh, you know, also the integration of components in the evaluation of a system of systems. Um, I also like to add... fixing, um, I mean, fixing the requirements at the beginning and not being able to update them during the life of the system, I think it's a, um, a risky assumption because today I think there is no system where requirements don't change. So that might be, you know..an assumption makes the whole approach. And I would put it...easy, easier to realize. I don't think it's a very realistic, so just my 2 cents.

**[P3]:** Well, I really agree with [P5] and [P2], eh, principally, because one of the main challenges of creating or integrating the...a system of system is the compatibility of constituents. And I see that one of the main challenges you have to make these approach feasible to be used...is because you are not considering non functional requirements, eh, you are more in the functional of the constituent system and you are missing some important, eh, constraints that, that constituents could impose over the system of systems. So, not only the compatibility, that is the, is the priority. If you, if you see..am, if you consider non-functional requirements, compatibility, or interoperability is one of the main requirements..aa...non functional requirements to be considered, but also about other, aa... requirements about security. Okay. That also is important here because we don't a as constituent system are independent and a, uh, independent of operation and managing ,you are not a really aware about what a risk that constituents could impose in the system of systems. So, I think the main challenge here... to you is not only to consider functionality, but also that, eh, quality attributes, if you are a, if you, if you purpose here is to focus on architecture, the non-functional requirements are very important. Okay.

[P6]: Yes. Well, it's actually only to say that I really agree on [P2],[P5] and [P3]. Yeah. Yeah. It's only that..it's only this.

[P2]: I'm just wondering if you are going to ask a question about the selection of the optimal variant, or we can comment here also about that part.

## **Q2.2: Which aspects could be improved and how?**

[P2]: yes, About the selection of the optimal variant, besides the thing that was said before that are very relevant about the consideration of different quality attributes and non-functional requirements in general, I would say that a, you probably may need to, uh, find a way to, uh, compete or avoid the competition with, uh, search based software engineering and software product lines. Because here you are, you are doing some selection of the optimal variant in a way that is quite easy to understand and simple. And, uh, and that's fine. On the other hand, there are these studies in the field of search based software engineering, in which you do the optimization, you create a lot of complex, let's say solution for actually complex problems...because you have probably many, many very large search space. I would say that probably in the system of system case, you may not have these very large search space. So your solution is adequate, but, uh, uh, maybe this, in this sense, the selection of the optimal variant may appear a bit too simplistic, you know, to, to, to let's say, you know, in the, in the papers, you always need that very complicated parts that, uh, that make it, uh, worth the research. And, uh, in here you may want to add something from search based software engineering, or you may want to rule it out, but probably you need to consider that.

[P4]: So, um, uh, to follow up the, the, the, the comments, um...I don't know if, uh, with your approach, is it possible to express, uh, dependencies? Um, because I mean, I see that, uh, if we go into your running example with the learning management system and all this stuff, but what happens if you select, uh, for example, for authentication, uh, uh, single sign on...that, uh, can, uh, make the cost of further functionality of integrations that say a race, for example, as a user management. So, in your case, you assign the cost at the design time Uh, um, because it depends on a single nucleus of system, but, uh, I guess in some cases, if you decide for an integration of the system, so this can, trigger uh, the raised of one of the cost of the other functionalities. So this was, uh, also related to what [P5] was saying that, so maybe you should consider to evolve this, uh, uh, maybe also at design time.

[P6]: Uh, well, uh, going through the same line, I, I was thinking about, well, it could be useful to add the integration costs or the interoperability cost in that, uh, function in those functions you were using to, to predict the better, uh, variant or the better coalition, uh, but how to measure the integration costs? or the interoperability cost between the constituents?, well, I I'm aware about, you know, a function point, uh...object point, but, but I am not really aware about some integration point function...something that we could predict, or, or if we have a table...and maybe this could be useful, uh, in the near future, because as, as we need to, to, to, uh, make those systems communicate, maybe this could be, uh, quite frequent. And so, uh, well, yeah, maybe this, this could be added to the challenge.

**[P4]:** Uh, so coming back to what [P6] was saying, so I guess if you want to estimate this, uh, integration, uh, cost at the first step, I guess this will make your product line explode, because you have to consider all the possibilities of integration, no?. So maybe, uh, it could be a good idea to add the refinements step. So after you decide, uh, so you select the variant, then you can estimate, uh, for what you have selected, uh, what are the cost of integration points...And then, so you have a refinement of the process, because I guess if you, if you try to do this in a single step, this will make the approach, uh, uh, unusable...or....not very helpful in the representation, but in a second step this could be... especially because I, I don't know what are the roles, who is the, uh, the architect or, uh, um, the analyst that can, uh, uh, estimate the integration because these are different systems. So you have to be aware of both, both of the systems.

### **Q2.3: How could the approach be validated?**

**[P5]:** This is tricky

**[P5]:** Um, I know what not to do, but, is ...uh, comparing the application of Vantess approach to, um... traditional development. So not applied to any variability management systems, because they could be simply unfair...unless just use it as a baseline in a bigger experiment. So just to give a, you know, a baseline for others, in a bigger experiment is going this way.

**[P1]:** I have a, meta-question sorry, [P5], have you...I mean... can I, can I follow

**[P5]:** okay

**[P1]:** So I have a meta question in sense...and it is related to one of my comments. So what are the stronger points that you would like to stress? And so what are the research questions that you want to, uh, to answer with the experiments, no? that we do the validation. So if, uh, again, if the strong point of Vantess is the fact that we are able always to identify for instance, uh, the best configuration, then you have to define the goodness of functional. No?. Um, and then we can define the research question accordingly. So yeah, the research question is what are the strongest point that you want to stress... related to Vantess and that we want to show with the validation. So maybe to answer this question, so this Q2.3 question, maybe we should answer to this one

**[P5]:** when is Vantess successful?

**[P1]:** No, because I mean, if you put it this way is related to correctness of Vantess. uh, what I'm saying is, uh, um, when Vantess is helpful?, so is really helpful? So it, because it helps to reduce the time in identifying the best configuration? So it's, it's a matter of a timing goal? or it's... you know? Yeah. I don't have no idea answer. I'm just thinking the loudly. So, [Moderator] this is what,...uh...what uh I have to add...I have to say

**[P3]:** Yeah. I think that, uh, sorry, [P2]. I opened the microphone before, raise my hand. Um, I think that [P1] puts an important question here, because if you analyze Vantess, eh, you see that it's the combination of techniques that are well, for example, a KAOS is well proven from requirement engineering, so it works and it has some value for that activity. Okay. And you are, um, you, you use some techniques that already exist and put together to create your, your approach here. So, are you, are you looking for a validation of the entire approach? or maybe the last phase of your approach? That is the cost..the part of the...the optimization of the, of the selection of the constituents. So, that is important to, to clarify, because, eh, you have already used some approaches that we know. Okay. So that part, what part of the your approach you want to validate?

**[P2]:** yeah. Uh, besides agreeing with the both the points. So like we want to evaluate the usefulness of this approach. And so, you explained, uh, what is your focus of the evaluation... And that's fine. My, eh, suggest...I would, I validate this is I'm asking myself. I would do probably...the best way and feasible way would be...to do a controlled experiment with students. So, you probably give them a bunch of requirements for a possible system of systems...that like they are the architect...and they use the approach for, for example, getting some code from, uh, uh, some software repository, and select a different software, combine them to achieve the goals that are written in the requirements, so follow the approach in a, let's say....toy constrained context, and then you give them a questionnaire or about the usefulness, or you evaluate even the output to see if there are differences in the software that they chosen... in a, uh, or a, maybe you can do even, even interviews to the student to understand what are the difficulties, what was easy, what was not...just to...just a remark, these, eh, related also to what [P1] was saying. Um, it is important to identify what is the strong point? What is your selling point? Is it useful is okay. But I would say that probably a good selling point could be that it is easy to implement... easy to, uh, to use. And so maybe it could be also be seen as a good educational tool. So an educational tool for, uh, starting some students that are not confident, even with coding, uh, with their development of these types of systems...in this sense, the controlled experiment... I'm just imagining a possible situation could be carried out even with, uh, students that are not from computer science, so they don't code... but they could use these approaches to combine different pieces of software. These, these are just, uh, ideas...possible, uh, possible usages. ... possible validations, if they are in line with your goal... Of course.

**[P6]:** Uh, well, uh, since the question is how could the approach be validated, uh, one possible way is using simulation. Uh, you could use a simulation model, uh, okay. This is not really obvious. So you would need someone that has some background on it... but it could be possible to simulate some, some SoS variants and, and achieve, uh, their result predicted by your, your approach, like using the functions. And so you could achieve the same, uh, result maybe.

**[P3]:** Okay. Uh, eh, I just have a comment about the [P2]' proposal of using the students for this validation, because one of the, eh...as an architect here...I see one of the main challenges of use these...this approach is to estimate...the architect have the acknowledge and experience to estimate the effort on the cost of a configuration over another. So, if...I think that you need to, to consider expert architects that could, eh, have these experience and could have estimation, eh, closer to reality. And so you can use, eh, make some



experiment, eh, with them, um, and, and take some feedback from them because eh, if their approach is oriented to facilitate or be applied for a system of system design. So I think the, eh, the focus here could be the architect... and an experiment, or maybe a survey with them could be an approach for this, eh, for Vantess. Yeah.

**[P1]:** Yeah. Just to add another element that I was thinking of, um, further then, uh, validating and assessing the usefulness of the approach, uh, as we are discussing now, in any case, I think that it is important to show that, uh, the, the solutions that the Vantess is able to, uh, to reduce are correct. And to this end, I would use something similar to mutation testing, you know much more than... better than me. So I would introduce, for instance...I would intentionally change or introduce some, uh, some changes in the inputs of the system, like, you know, changing some costs. And then I would then look at the, the produced outcome and to compare the outcome of, with what, what would be the expected one. So in this case, you are able, as one of the research questions is that, uh, Vantess is able to produce a correct configuration or correct solutions.

**[P5]:** Maybe a last point. Ahh... independently on the type of evaluation that you're going to do. I think it's important that you do it on more than one system, uh, and across domains...because different domains may can tell different, you know, practices and behavior...

**[P4]:** I wanted to ask you, um, what is the status of the...let's say... the approach...In the...because, I mean,.. you are asking how to validate, but I guess you already started to use it for the running example that you show, right?

**[P4]:** And did you find any other possible candidates? As a system of systems that can be benefit?

**[P4]:** But it is enough to, uh, have the model, so a specification of the system to drive at the current stage, or do you...

**[P4]:** hmm..no...I was thinking that, uh, last year we presented a paper at I-Cities uh, that maybe you can be a good candidate to, to try to represent with this, uh, this first stage. It was about, um, alert management systems and, uh, and it was a system of systems of, uh, um, the, um, the system that the civil protection uses for letting people when they have this, uh, overflowing or this kind of, uh, risky event. So, uh, continuing this, or maybe I can send you the paper because it's a short paper and you can, uh, just, uh, have a look...if you're interested. And considering the approach. I think, uh, it is of course, a hot topic. It seems to be useful, at least from the presentation, but I would focus more on the, uh, also on the motivation side because, uh, after the discussion is more clear to me, what is the focus on what could be the benefits. Uh, but from the initial presentation, I, of course I'm a bit out of the topic. So I, uh, I had to, um, uh, think about it, uh, um, more

**[P4]:** It's a...more or less from my side

**[P1]:** Yeah. Um, so according to what I understood, it seems that, uh, these, uh, uh, first part that you presented today of the approach is at the end, independent from, uh, the actual, uh, environment, um, where did the systems of systems, uh, will be, uh, will be deployed or the deployment environment. So I'm thinking that maybe this approach can be useful for, uh, uh, managing constituents systems that can be microservices or can be, uh, third party software libraries, or can be even, uh, um, you know, packages...Linux packages for...where you have, you can have this notion of a package that contribute providing some functionality, and maybe this is a, uh, a point that you can investigate if it can be stressed, because at the end, what, uh, you would need to implement technically would be just, um, uh, you know, you will have a same meta model where the meta model would represent the concept of the constituted....constituent system and then the, the system can be, uh, refined, or instantiated in terms of, uh, uh, as I said, services or microservices or other kinds of artifacts. And the thing that...this can be a possible, uh, uh, stronger point with the paper, because this would not change the theory that you have presented today. So, then just a matter of a properly inject or..., I mean, move on, I mean, attach, uh, the, the, the, the environment of the technology of the space that you want to address a link to these, uh, uh, general meta model that you can use for presenting what you have done....what you have showed today.

**[P5]:** Uh, yes, I agree with [P1], and, uh, maybe another, let's say technology where you can apply this is in robotics, whereas, you know... nowadays there are many, let's say mini systems that's are available in robotics, like for managing vision, object recognition or whatever... navigation.. that are really implemented completely independently of the robot where they are going to be run into...or this might be, you know, also a nice way to show off a bit what you can do with the method. Um, thinking about the configuration, if I think that if we remove the systems of systems flavor to the approach, uh, yeah, for sure you make it, uh, technically more, um, let's say...to me it's interesting because then you really, instantiated it into a concrete technology, but then I think you will have the additional competitors that you need to take into consideration, because I think that the novel...the novel part was really the application of the variability into the SoS, uh, at the SoS level, not at the system level. Um, but I also recognize that doing research when you propose a new method or a new process, it's super difficult because really... it's not the tool that you run an experiment and now you're done. It's really, it's more challenging. So, I mean, I want to praise your courage.

**[P5]:** I have another point, but I think I forgot about it. Yeah. Maybe I will raise my hand again.

**[P3]:** Okay. Eh, well, uh, I think that one, one way to make the validation feasible for you, it's, eh, using technologies that are already exist and, uh, eh, eh, some kind... easy to you access, for instance, there are so many, eh, repositories of smart cities, eh, information, and you can use that information to simulate some smart cities system. That is a kind of system of system. You think about it, uh, and you kind of use some kind of platform as, um, I think it was, uh, [P4 ]or [P2] proposals to use microservice. I think [P1], uh, okay. And, uh, you can simulate as a smart city. And you,uh.. you can test your, uh, approach with that simulation because you can access some real data from that repository service smart city. You can use...microservices to create that constituent systems in some way...you can a have, um,

some metrics to estimate the cost or to play in some ways that simulation or some experiments to, to know, um, how, if some changes in these, in this service, how these could, eh, could affect the cost of integration... of the cost of security or something like that. So you can, eh, my, my observation here is you can make yourself a thing that already exists and you can adapt to create your own system of systems.

**[P6]:** Yeah. Uh, well, I want to say that I agree with [P5] about robotics. Uh, I think the, the robots are really good instances of independent systems that could cooperate in a system of systems. And by the way, uh, in the SoSE conference that, international conference from IEEE on system of system, they had a special track on systems of robotic systems, I think this year or, or last year. So this is a kind of hot topic. It's interesting, uh, in about the microservices. I only have some, some concern about it because when we think about systems of systems, the constituent parts are systems. So, uh, the concept of system, uh, should be discussed. So I understand that microservice, maybe, um, it's it's, as the name says, it's a kind of micro, I, I'm not sure it could be classified as a system, but it could be that interface that connects that, that enables to connect to a big system. And, and I only to, to contribute now, I think we can, we can say that, uh, in the beginning, someone asked, uh, was the instances of systems of systems and something that it's not a system of system. And so, uh, I, I like to say that a system of system is for example, smart traffic, uh, system, because you have the autonomous cars, they are totally independent and they can join, they can leave. And they are really, uh, an example of independent system cooperating to a, um, a major, uh, goal. And the world banking system is not a system of systems... why? Because the systems, uh, do...don't have operational independence, they are exclusively dedicated to that system. They cannot, uh, you know, uh, join or leave the system at any time. When you think, uh, on, uh, ATM, uh, uh, machine, for example, they are there and they are exclusively dedicated to the entire system. Uh, when you have the information system in a banking, they are exclusively dedicated to that. They cannot join or leave. And so the world banking systems, uh, we understand that they are not, uh, systems of systems. Uh, I think that's it. Thank you.

**[P2]:** Uh, yes, no, I, I didn't have anything more to add. I just want to join, uh, [P5] in saying you that you have a lot of courage in proposing an entire method and not focus on just a tiny little bit. So, uh, I think, uh, I think it's good. It's good to have research like that. So just my remarks, I think I've said enough before.

**[P3]:** No. It was just the comment that I put in the chat

**[P3 chat message]:** "just to register here, microservices can encapsulate the capability offered to the SoS"

**[P1]:** Exactly. That is the point

**[all]** Thank you. Bye-bye