



# What Influences How Stakeholders Collaborate in the Cyberinfrastructure World?

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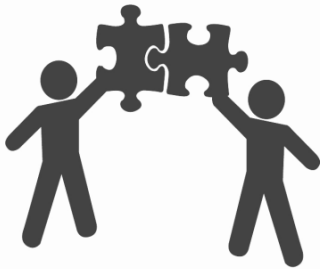


## INTRODUCTION

Cyberinfrastructure (CI), also referred to as e-science, is an immense database that stores and organizes data while allowing users (researchers, scientists, doctors, etc.) to communicate and share large capacities of information. Collaboration is a key strategy when it comes to working in CI because of the many tools and functions within its use. This leads us to examine, *What influences how stakeholders collaborate in the cyberinfrastructure world?* This poster examines 3 key concepts that influence collaborators working in CI. The concepts displayed are roles, motivation, and environment. Within those concepts, it's further demonstrated whether these collaborators are domain scientists or computational technologists; work together for personal gain or for the greater good of a group; or work in an institutional or interpersonal setting. We found that these different forms of collaboration affect their collaboration styles.

## METHODOLOGY

Through qualitative research of 113 interviews nationwide, grounded theory is used. The data has been coded for the purpose of unveiling key themes and to develop strategies and practices to facilitate. The purpose is to develop strategies and practices to facilitate the adoption, diffusion, and implementation of CI with new and different groups and organizations. This poster examines 12 interviewees who discuss their collaboration styles of their CI work experience.



## CONCLUSION

Because of the vast amount of knowledge drawn from different work experiences and backgrounds needed to understand and use CI, collaboration is key. We have identified 3 key concepts that influence stakeholders' purpose for collaborating as well as their collaborative styles throughout their CI experience: roles, motivation, and environment. We have found that these different factors can affect the degree of collaboration (relational closeness), chronemics (how much time spent together), and the concept of the give and take effect.

## 1. ROLES

Most of the time, domain scientists -- whose work aligns with a specific discipline -- cannot do CI without the help of a computational technologist on site. They collaborate with computational technologists who contribute by doing the more technical work. While domain scientists practice one specific discipline, computational technologists can assist stakeholders across various domains. This is because computational technologists' skills aren't limited to one domain and are in fact needed by various, different stakeholders. Computational technologists oversee a larger range of domains because their help is significantly needed in order to proceed and become a successful user of CI. Overall, there is a balance in their collaborative efforts between complex aspects (from the computational technologist) and simpler aspects (the discipline that the domain scientist is focused on). From looking at perspectives from both domain scientists and computational technologists, we can identify their purposes and styles of collaboration.

## 2. MOTIVATION

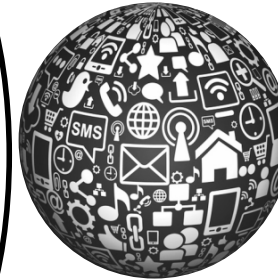
When stakeholders collaborate, they can be working for their personal gain or to reach a group goal. They can seek to collaborate in order to obtain information to move themselves further along, or they can collaborate for the purpose of accomplishing a task in a group setting. Their intent and motivation affects the ways in which they collaborate. When collaborating for personal gain, there is often less time spent collaborating, because the task is generally more in an urgent state to be completed. Stakeholders focus on efficiency and information gathering. Sometimes there can be tension in the environment developed by a sense of competition. Meanwhile, when stakeholders collaborate for the greater good of the group, there is a strong sense of teamwork and a focus on relationship building. There is more of a back and forth collaborative efforts that may be more time extensive. The concepts of open, collaborative sharing are encouraged. However, when engaging in CI, stakeholders often find themselves embodying both roles, whether simultaneously or at different occasions. For example, when working for the greater good of the group, they are also working for themselves as they grow and push themselves closer towards their individual goal and the collective goal.

## 3. ENVIRONMENT

In an institutional environment, collaboration is demonstrated through the interactions between the university and the faculty (stakeholders). This contrasts from an interpersonal relationship because the dynamics and goals differ. Institutional based collaboration can be viewed as the bigger picture of interactions. There is the give and take effect, which is displayed through the university funding faculty (stakeholders) through investing in their research, and in return, stakeholders are able to complete their research with the necessary tools and resources. The stakeholders give knowledge, credentials, and success to the university while being provided with the opportunity to conduct research and have access to CI. Interpersonal collaboration contrasts from institutional collaboration because it takes place in a one-on-one or small group setting, and is more focused on relationship building rather than a direct give and take effect.

## DOMAIN SCIENTISTS

- "So, like Aaron, who knows way more about cluster technology and... all of these heavy duty tools, versus me, where my perspective is more as a teacher or a research scientist. So, we can have a conversation and I can bring the perspective of someone... less willing to deal with a lot of complexity and the kind of annoyances that come with complicated computer systems. And then we can hit a more effective balance between complexity, but also clarity and simplicity."  
-Data Scientist, CA, 7/20/17
- "I'm an applied mathematician. I'm not a computer science guy or a hardware guy... When we have questions, we can ask these guys. They helped us with specifics on grant writing... We would never even be able to submit some of these grants without their help and just shooting ideas around and conferences... Without them, I don't think any of this would've really been possible."  
-Mathematics Professor, OK, 5/13/16



## PERSONAL GAIN

- "At NCSA, I have technical groups that I can draw upon, and since I'm building infrastructure, sometimes I need specialized skills, sometimes I need more people than I have budget for, and I'm able to obtain expert people on fractions, rather than smart people who have to learn the expertise and then apply it to me."  
-Scientific Computing Manager, IL, 5/20/16
- "There is some aspect -- the National Science Foundation, which funds XSEDE and expects us to act collaboratively, also in the way they support individual resources make us compete against each other. So there is a tension between the competition between the various sites and the collaboration which is effectively required in order to have a good infrastructure."  
-Physics Professor, PA, 5/19/16



## INSTITUTIONAL

- "What our center does to help our customers meet their mission is provide them with access to hardware, software, and services. It's our job to help a faculty member and their students be able to leverage the systems that we have here to do the best research they can with the resources we have available."  
-Computer Science Professor, OH, 2/24/17
- "...There was a sort of institutional energy behind interdisciplinary collaborations... It meant people working together... And as part of that work, you were always encouraged to go beyond entities and boundaries, departmental boundaries, even college boundaries. And so it was sort of in our DNA... It's never that, 'Oh, this is not something that I control, and hence I shouldn't spend time working on it.' So I think working as a team was always helpful. And we never saw our team to be only U of A or my department, my team. So the culture at the organization definitely had some impact because we are able to work across boundaries."  
-Director of Information Technology, AZ, 5/24/16



## COMPUTATIONAL TECHNOLOGISTS

- "I started supporting other fields like genomics research. I help... to support researchers, make their workloads... more efficient... I also help out the social sciences people too... At Northwestern, the research is very collaborative. So it's really impossible to get on with one field and not to branch into others."  
-Computer Scientist, IL, 7/20/17
- "I tend to work with other domain scientists, a range of people who have little experience with computational work all the way to technologists who probably know more than I do... Yeah, so I have, yeah, multiple projects, ranging from archaeologists and paleoanthropologists who do field research in South Africa over to folks who do disease and hazards work and then, yeah, some of the computational folks as well."  
-Computational Geography Professor, OH, 3/14/16

## GREATER GOOD OF THE GROUP

- "We can do the collaborative approach and say -- Hey, if we build this, it'll serve all of you... Can we all come together and work on that? ... We came up with a vision for how we could build something on campus and then we called all the researchers together and said -- Give us your feedback. Tell us what you think. Would this help your research? And we got all kinds of feedback. Very positive. And then the work that we made them do afterwards was write us a two paragraphs of what your research is and how this would help, because we needed to put that into a proposal in the end."  
-Director of Strategic Technology, NH, 7/17/17
- "Data is, used to make the world a better place and data should be shared openly or collaboratively and creatively, not necessarily for destructive or profiteering purposes... It's the betterment of mankind rather than just profiteering."  
-Enterprise Architect, OK, 5/19/16

## INTERPERSONAL

- o "We are collaborating on a couple different projects... We have weekly meetings and use online collaboration tools to assist with us having that meeting and communicating about the code we're building outside of those meeting times... We know each other, we meet each other in person a couple of times a year. So, we're kind of comfortable with one another in that sense... We've tried different collaboration tools over the years. We've refined our approach over time... We're at a point now that it works pretty smoothly."  
-Water Resources Engineer, VA, 4/27/17
- o "I teamed up... with one of my senior people... and I really got excited about the approaches he was taking and I built a program around him. It's now our largest program and it accounts for probably 80% of all the grants that we bring in... So he and I have built the National Geothermal Data System with Department of Energy funding."  
-State Geologist, AZ, 5/10/16