Funding, Structure, and Shared Responsibility: Macro Conditions Shaping the Computational and Big Data Movement

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Introduction

With the increase in virtual organizations for e-science tool development in the 21st century, it has become important to investigate what shapes the products of these projects for distribution and world-wide tool usage in the sciences. This poster looks at the macro conditions of funding, organizational structure and motivations of virtual organizations that shape the computational and big data movement.

Theoretical Perspective

In motivating a successful virtual organization, one of the ideological conflicts found by Kee and Browning (2010) was the dilemma between building cyberinfrastructure based upon one's own theory and methodology or on a competitor's theory and methodology. The problems and limitations of the scientific environment was well documented such as in a study conducted by Casey (2010) on developing trust in virtual organizations/ teams. Besides encouraging the usage of communication media options available, Casey (2010) emphasized the value of evaluating the virtual organization/ team as a whole (compared to geographically dependent variables) because all team members were united toward a common goal which in turn incentivized trust and cooperation, therefore increasing the effectiveness of a team.

In terms of organizational structures of virtual organizations, Leonardi (2009) talks about the relationship between technology and organizations. According to the structuration approach, wherein technology is static while organizations are dynamic, Leonardi (2009) believes that it is through the appropriation of technology and co-currently the change in work practices by the technologies advantages and limitations, the new technology/tool itself is changing the structure of the organization itself. Also, Kee and Browning (2010) state that the organizational structures such as the NSF, universities, federal agencies, and local state governments have explicit policies for funding science or technology

Funding is the source for computational tools and virtual organizations and in terms of funding structure, Kee and Browning (2010) state how the different factors involved in cyberinfrastructure, such as the institutions, individuals, and ideologies need to be coordinated as the basis for cyberinfrastructure projects. For individuals, there is no financial compensation for pursuing technological advancement and thus are forced to choose between unrewarded service to the cyberinfrastructure community or building their tenure case via publications for more funding and academic prestige.

Methodology

This poster employed the grounded theory approach (Corbin & Strauss, 1990) and analyzed 25 interviews conducted with domain scientists (in bioinformatics, computational chemistry, theoretical physics, etc.) and computational technologists. Interview participants came from across the US (including CA, IL, IN, SC, MI, TX, etc.) and three from the UK (specifically Scotland). Interviews range from 16 minutes to 2:25 hours, with 10 conducted in person at the Supercomputing 2013 conference in Denver, and 15 over the phone, between Nov 2013 and April 2014. Guided by the stated research question, the co-authors performed multiple iterations of data analysis and literature integration, yielding preliminary findings presented in this poster.

Findings

Funding

National policies shape the development of the big data and computational movement in different countries. For example, US policies encourage internal competition among US researchers to get funding from the same few funding agencies, and discourage collaboration with international partners. Whereas in Europe, collaboration among EU countries is necessary for bigger funding at the EU level, due to smaller fund pools and less resources to work with within smaller EU countries. However cooperation outside of EU is restricted. There is a lack of world wide funding agencies and organizations to push cross-continental collaborations. As a knock-on effect, than American tools as American researchers have the funding to develop specific tools and continue investing time and money into them whereas tools in Europe have more general designs and thus diffused and adapted across other European countries.

"In the US, all national labs tend to have their own tools that they develop and they use for their own specific use whereas in Europe we don't really do that; we don't have the money for that. So we tend to… there tends to be tools that developed in certain places and then used by everybody…"
(Center Administrator, Edinburgh,11/18/2013)

"For example as a US researcher it is often extremely difficult to collaborate with international partners because there are few international opportunities for funding that require US participation. For example in Europe that is not the case, the European tend not to be outside of that either."
(Theoretical particle physicist, Chicago, 3/19/2014)

Structures

Hierarchical structure of organizations are thought to be necessary, wherein team tasks are delegated and divided with section leaders interact on daily basis to ensure time track. In these processes interviewees recommended the use of collaborative tools in CI organizations such as data repositories and teleconference tools. One interviewee noted how the current organizational structure is thought to hinder open-ended thinking due to the attention to money allocation on projects which lead to a lot of micro-management including progress reports, keeping track of produced papers, and setting milestones. Another interviewee remarked how in academic settings cooperation from other departments and facilities should be encouraged while another researcher highlighted a problem in this setting by pointing out how university faculty prefer their own developing team rather than seeking outside help.

"Say for the project I run, I am overall in charge, and I bring everybody together, and there's a sort of hierarchical structure where people are in charge, and I talk to five people, and those five people talk to other five people, … the key interactions are just between me and what I call the work package leaders…."
(Center Administrator, Edinburgh, 11/18/2013)

"It's been, in fact, a problem more recently because there is now more top-down direction, and that means that a lot of what you're doing is more short-term, even when they're all talking about it being … if you're going to do that, you're going to say, okay, well we need milestones and we need this sort of progress reports and what not, and if you're trying to do open-ending thinking, it's kind of hard to do that with milestones…"
(Computational technologist, Champaign-Urbana, 3/2/2014)

Motivations

The conceptualization of virtual organization projects are important in determining the success or failure of the computational tool. Interviewees commented on what they thought was important as well as the problems in the computational tool creation process. One cited the mistrust between the computational scientists and the domain scientists, resembling it to a railway track analogy recorded below. Another talked about the need to instill a sense of shared responsibility and shared objectives for both disciplinary and interdisciplinary projects. However, in terms of interdisciplinary projects, another researcher remarked how communication between domains is "terrifyingly bad" and proffered increased interdisciplinary conferences as a solution to this problem.

"Things that can happen in a distinct way that really doesn't work, part of the reason is there is this umm mistrust between computer scientists, the tool developers, and the domain scientists who are actually users."
(Research Systems Architect, Indiana, 11/18/2013)

"Like laying a railway track…This building is building this side of the track, …but what happens is there's like this track comes this way, because there is an offset of like what-"
[Interviewer]: "So you are saying that railway track um actually don't align up…"
"They don't line up."
(Research Systems Architect, Indiana, 11/18/2013)

Well I mean ah I actually think ah, by the way, a lot of it goes back to the notion of shared objective, or common objective. Ah I used to think that money plays a big role, money plays a role, but actually the objectives are more important.
(Supercomputing center manager, San Diego, 11/21/2013)

Conclusion

From the data gathered, the research team highlighted the various macro conditions in the scientific environment that shape the big data and computational movement which include, funding tensions, organizational structure, and motivations of virtual organization teams. One of the main points gleaned from this study is that the conditions of the structures in the big data and computational movement itself influences behavior of the involved parties. In other words, various limitations and advantages of the funding tensions, organizational structure, and motivations of the virtual organization teams themselves shape the way computational scientists, domain scientists, institutions and federal agencies act in the way they do in this scientific environment. For example, it is the very restrictions that the funding institutions place that prevents international cooperation on a wider scale in the computational and big data setting as well as the fact that there is a huge difference in the mindset of US and European virtual organizations due to the amount of funds and funding opportunities available (if not lack thereof) which creates a competitive framework for American scientists in contrast to the cooperative nature of European virtual teams. The community itself as a structure shapes virtual organization behavior as its scientists and technologists are resistant to engage with other fields and domains while concerns over funding and deadlines eliminate long-term thinking and tool adaptation/diffusion. Finally, staunch mistrust between the domain scientists and computational technologists prevent and the lack of multidisciplinary projects/leaders hinder and restrict the innovation and streamline the virtual tool creation process. This research project has wide implications for all virtual organizing/teams and interdisciplinary projects, further research may be necessary for suggestions on how to improve the scientific environment of the computational and big data for maximum efficiency and success.

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