Autonomous Vehicle Study Builds Bridges between Industry and Academia

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Researchers have long explored the desirability and benefits of industry-university collaborations and acknowledge they can be fraught with difficulties. We examine one such alliance, focused on driverless cars, a current hot topic in the public imagination and in technology design. Our collaboration began as an alliance between two anthropologists, one a professor at the University of North Texas, the other a consultant with the Nissan Research Center in Sunnyvale, California. We designed a research project for a design anthropology course that Christina Wasson taught in Fall 2014. Brigitte Jordan, at the time, was conducting an informal ethnography class for engineers and computer scientists at NRC. Our alliance had two objectives: to determine what a successful industry-university collaboration could look like when it involves ethnographic research in the high-tech sector, and to provide insights into usable ethnographic methods and data that would support social and cultural questions in autonomous vehicle (AV) research at the Nissan center. We found these two geographically separated classes eventually allowed building bridges across academia and industry, anthropology and engineering, leading in the long run to some softening of the boundaries between the two disciplines. Here we discuss significant variance in the research cultures of class participants at UNT and NRC (ethnographers and automotive engineers), and the various manners in which these differences were bridged over the course of the project (or not, as the case may be). We explore factors which inhibit or encourage exchange between university and industry micro-cultures, consider reasons for the success or failure of such projects, and offer suggestions for improving future collaborations. We end with ideas about what a model for productive industry-academia collaboration could look like.

> The robotics stuff is easy. What is difficult is the human stuff. (Roboticist)

INTRODUCTION: QUERIES AND POSITIONS

Autonomous cars. Driverless vehicles. The driverless car is clearly one of the most exciting, portentous, implication-packed developments in the current media generation's basket of historical events. It raises deep questions about an impending round of cultural and socio-political changes that will outshine and outclass those generated by the arrival of Mr. Ford's Model T in 1908.

Imagination is running high in public media and hallway conversations. Social encounters are full of imaginings: What would it be like? Could it drop the kids off at school without me? What if there is an accident? Who or what would take over? Can you hand control of a crashing car back to a driver who is blissfully zoning out? Could we get one for my father who is half blind?

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As the staff writer of a popular magazine put it so eloquently, with a looming legion of aging hands behind the wheel, skill atrophy is seen as a real risk. At the same time, economists warn that the end of a century of private car ownership would send shock waves through the economy and society at large (Dudley 2015). There is fear of robotic cars, of technology running amuck, of unknowable consequences, and at the same time elation, joy in anticipating liberation from being tethered to a place as is often the case for aging people and those with disabilities, liberation from endless hours of searching for a parking space, and in general the joys of being freed from many of the limitations imposed on us by our current transportation system.

There are many bridges to cross, many boundaries to overcome before the fear/hope barrier is breached, in automotive design as well as in public and private minds. So how do we get from here to there? We are suggesting that the best way (or at least one good way) of doing that is to look at our current attitudes and practices about cars in order to explore where the opportunities for crossing and connecting lie.

We might ask a simple question as did a group of automotive designers, who wondered: "What are we actually talking about when we talk about driving?" With this question in mind we carried out a project, the Social Life of the Car (SlotC), to explore how ethnography and design anthropology could help us see how we might pass from our present to a future AV state, particularly looking at the relationship between industry and academia, in our case represented by a Silicon Valley high-tech research center and a university class in applied anthropology. The goal of the project was to better understand current driving practices to see how they might portend ideas about the autonomous vehicles of the future. The project involved ethnographic research by a class of students under the mentorship of their professor Christina Wasson, with guidance by Brigitte Jordan who as the "client contact" was the deeply involved liaison to the Nissan Research Center in Silicon Valley. Jordan had begun a series of ethnographic modules to members of the Lab community in an informal course that LabPeople attended as they were able to, with varying degrees of involvement and accomplishment.

The interactions we observed throughout the project in many ways could be seen as an ongoing conversation between industry (in this instance mostly the Nissan Lab) and academia (here the UNT class) to describe and make sense of the exchanges between the cultures of "LabPeople" (initially mostly through Jordan) and "ClassPeople" (with Wasson holding a special status as professor).

Introducing the Class: University of North Texas as an Example of Academia

The UNT Department of Anthropology offers a strong launching point for a bridge from academia to industry because it has an applied focus. All faculty conduct applied work, and the master's program prepares students for careers in practice. The department explicitly subscribes to the view that theory and practice are closely intertwined and this interdependence shapes the design of the master's program. In the design anthropology course, Wasson combines aspects of a traditional class with features of a consulting project (Wasson and Metcalf 2013). It is like a conventional class in that students read and discuss relevant literature; they receive grades from the professor; and the timeframe parallels the official semester. It is like a consulting project in that all students work together on a research project for an industrial client. Wasson has taught such courses for 16 years.

Introducing the Lab: the Nissan Research Center in Silicon Valley as an Example of Industry

The Nissan Research Center in Silicon Valley (NRC-SV) is a high-tech automotive research laboratory where engineers, computer scientists, roboticists, automotive designers and data specialists work on designing the autonomous (driverless) car of the future. It is in many ways similar to a series of competitive automotive industry labs popping up in Silicon Valley. The Lab knows that plans for the cars of the future need to address not only technical aspects of car design but also the important, non-technical, human-focused features that make cars truly desirable and useful for people. NRC, under the leadership of its director Maarten Sierhuis, is unusual among automotive technology labs in that it takes ethnography and design anthropology seriously as ways to make human-centered technology design possible. As a matter of fact, a well-known Lab roboticist told us: "The robotics stuff is easy. What is difficult is the human stuff."

Jordan, a consulting corporate anthropologist, has been working at the Lab as an advisor on ethnographic methods and approaches, charged with supporting the "H" in HMI (Human Machine Interaction and Interface) by instilling ethnographic and people-based thinking in the Lab's tech community. She had started to teach a weekly course there on ethnography and design anthropology earlier in the year.

Introducing the Class Project: The Social Life of the Car

The class research project on the Social Life of the Car (SlotC), was intended to take a first step toward understanding the human dimension of the human-machine interactions that constitute the driving experience. What do cars mean in the lives of drivers and passengers? How are they embedded in social relationships? How do drivers interact with the dashboard, the road, pedestrians and passengers?

In the fall of 2014, 18 students signed up for Wasson's design anthropology class to investigate what drivers actually do when they are driving. In teams of two, they accompanied 9 study participants on some of their routine drives, observing and video recording their activities. They carried out pre- and post-driving interviews, also recorded, resulting in three data sets for each of 9 drivers. These data were analyzed in a largely collaborative process in which teams pooled detailed fieldnotes written from their recordings and analyzed them for shared behavioral patterns across the 9 drivers. (For details, see Jordan et al. 2015, Wasson et al. 2014.)

The research design was constructed by Jordan and Wasson who together thought through how to manage this project towards success, in spite of stiff pedagogic requirements on one side and unstated, ill-defined desires from various stakeholders at the Lab on the other. A major advantage was that they knew each other well and were familiar with each other's work. Jordan had taught at a large university for many years before turning to high-tech work and Wasson had worked as a consultant in high-tech companies before entering academia.

The overcoming of boundaries through bridges or other means (such as fusion, decay, or intentional tear down) has been discussed from a variety of different perspectives, such as digital formations (Arthur 2011), (socio)digitization (Latham and Sassen 2005), blurring

(Jordan 2009) and more. Here we will use the idea of bridges both metaphorically and in the sense of physical, organizational and ideological structures that provide mutual accessibility, a crossing, a passage from one side to the other, while carrying all manner of "things" including people, ideas, news and objects such as video recordings and pizza slices.

In the following pages we look at the SlotC project reflected against internal teaching efforts carried out by Jordan at the Nissan Lab around that time, as they build bridges in a world of disciplinary silos (Tett 2015). Where the cultures of academic anthropology and engineering are separated by strong and well-honed boundaries but connected by bridges in many stages of construction, these kinds of industry-academia collaboration generate not only exciting possibilities for students. They also build bridges for professional disciplines and socio-economic organizational structures such as industrial laboratories and university pedagogic/entrepreneurial institutions, often in bricoleuring fashion, that can accommodate the needs of these different territories and -scapes.

AN INTERLUDE: THE CULTURE THING

Culture Defined

Yes, like it or not, if you are an anthropologist, even a design anthropologist, you have to talk about "culture" – whatever that is. We'll skip over our anthropological ancestors who established the foundational definitions (but see Kroeber, Stocking, Boas and Geertz in Wikipedia), and find one that works for us.

Culture is one of those slippery notions that get attached to phenomena that are volatile, not easily measurable, kaleidoscopic, and as such are forever dependent on research direction and definer's intent for taking on their local meaning. As a consequence, there are many definitions of culture. For our purposes, we might define it simply as a system of experiences we share with other members of the social groups within which we live, resulting in similar patterns of behavior (habits) and ways of thinking that are, to a large extent, subconscious, unexamined and unquestioned.

With this definition, it is easy to see that all of us are multicultural, that we carry with us multiple cultural systems consisting of micro-cultures of varying importance that are shared to different degrees with others. They are activated in different situations and for different purposes.

How do we acquire culture? We start learning a variety of cultural systems beginning at birth and continue to gain new ones throughout our lives. These early, repetitive experiences shape a "worldview", deeply ingrained expectations for ourselves and those around us. They determine accepted forms of behavior, modes of thinking, the shape of artifacts we like, the kinds of functionalities they are expected to exhibit, as well as general likes and dislikes, from food to cars to marriage partners. Thus we may speak of organizational culture, bathroom culture, soccer culture, driving culture, designer culture, and more. Micro-cultures are changeable and shapeable through new experiences, including persistent teaching. That is how disciplinary cultures are formed. Plainly, interaction and cross-communication is easiest if individuals have at least some micro-cultures in common.

Disciplines as Cultures: Anthropology and Engineering

How do LabPeople and ClassPeople acquire such different worldviews? A major contributor is their "formation", their disciplinary upbringing (Knorr-Cetina 1999). Anthropologists typically develop their skills through years of graduate education that includes immersion in fieldwork and a professional environment that is shaped by their professors and their cohort. They are taught in small groups by experts in a process that emphasizes heavy reliance on qualitative methods and is characterized by an ideology of participant observation, personal involvement, and natural experiments. For them, problems are always multifaceted and open to multiple solutions.

For people coming from engineering and the hard sciences on the other hand, problems tend to have single answers. They subscribe to an ideology of scientific experimentation that involves predetermined variables and statistical hypothesis-testing of quantitative data. They tend to see themselves as impartial scientific observers – almost as data collection machines that document sites, events and interactions objectively rather than as participant observers, continuing to attempt to embody the ideals of the deductive, laboratory science that had established their identity (Jordan and Yamauchi 2008).

We become aware of how culturally contingent our existence is when we find ourselves with people who did not experience the same enculturation process. All of a sudden things don't work well anymore. They just don't see things the same way we do. They don't know that when we ask for a report we expect a story and not just a naked set of slides.

It is these kinds of cultural differences that maintain disciplinary silos. Crossing the distances between them requires generating and supporting new micro-cultures that allow exchange and mutual adaptation that can lead to some form of mutual appreciation and even collaboration – an approximation to a shared state where the borders slowly become more permeable, where common grounds and a common language can be established. For us, in the liminal space between business and academia, teaching emerged as a major way of supporting and tracking the emergence of bridges and flows between the silos.

TEACHINGS BUILD BRIDGES

When Cultures Clash

When discussions between hard scientists and social scientists turn from a casual, friendly conversation into something that sounds more like a defense of national treasures, we are witnessing a battle between two disciplinary micro-cultures, each with its own entrenched arguments. There is no way to resolve these issues during corporate-sponsored hamburger lunches. But in cross-disciplinary encounters like the SlotC project, there is hope of superseding the disciplinary sparrings with increasing understanding and appreciation (though not necessarily adoption) of the others' point of view. How did this play out for ClassPeople and LabPeople? What was the state of mutual understanding at the beginning of the semester?

How the Students Saw It

The students in Wasson's class had a mission. They initially imagined that they would be showing the computer scientists and roboticists at the Lab what an anthropological approach to their problems would look like and what recommendations it could produce for the design of autonomous vehicles. There was an instructional intent clearly present in the students that was a major contributor to their wild enthusiasm and contagious dedication to the class. With their professor's guidance they would be able to come up with findings that would be valuable contributions to the development of Nissan's driverless car of the future. At the same time, they had no idea of how ideas get into a product nor of how long it takes to get a car to the market. They did expect that their design implications would be of active interest to their counterparts at the Lab.

How the Lab Saw It

Most engineers at the Lab did not have a history of engagement with anthropology or ethnography before Jordan started working there. In order to familiarize them with concepts and approaches basic to design anthropology, Jordan had earlier initiated a weekly course on ethnographic methods. Through the conversations that emerged, some engineers began to become somewhat familiar with vocabulary, methodology and basic philosophy of ethnography, at least at the verbal level. After six months, some of them began to grasp what participant observation is, that interviews and observations carry different kinds of bias or that what people say and what they do is not necessarily the same. But they were barely aware of the SlotC project and what the students in Texas were doing. Nor did they care much. SlotC sailed under cover.

Nonetheless, awareness of Class research activities did slowly creep into consciousness at the Lab, primarily through Jordan's class lectures and conversations, even as news about Lab engineering realities began to seep into ClassPeople's awareness through the class sessions Jordan attended remotely. Awareness gained momentum as issues and later tentative outcomes from the project emerged, discussed in depth during and after Jordan's three trips to the university. Still, for quite some time it was unclear what the SlotC project might mean to the Lab and what if anything it might be able to contribute to the objectives of the Lab, its designers, and its decision makers.

The Flows of Teaching: Push and Pull

As time went on, we slowly began to witness not only occasions where students on both sides came up with insights about the other side's work, but also an increasing understanding about complementarities rather than oppositions. We saw that the border crossings we witnessed were happening in two-way flows: one going from the Class to the Lab (anthropology culture to engineering culture) and the other going from the Lab to the Class in a mutual process of rapprochement. So when we talk about teaching here, what we really mean is flow, flow formal and informal, physical and immaterial, real and virtual that crosses borders by push or pull. Formal teaching produced the active, intentional information push that certainly happened in Wasson's and Jordan's classes, but we would maintain that it was the largely invisible pulls on knowledge and practice that students and LabPeople exercised on each other that made for successful bridge crossing and jumping (as the case may be).

There were multiple informal exchanges over the internet and at professional conferences that built bridges through the focused efforts of student researchers who sought out LabPeople and vice versa. These informal flows were definitely a major factor in softening the boundaries between Lab and Class. We consider it quite likely that the relative absence of informal flows contributes to the failure of a large number of joint industry-university projects, since it seems to be the informal that carries the joining of imaginings from both sides and the building of strands of shared micro-cultures.

Tracking Success? Some. Maybe.

Throughout the semester and beyond, an important question was: how can one assess the effects of teaching efforts in complex situations of this kind. Is there a softening of boundaries? Is there an increase in mutual appreciation? Is there a difference in language? We tracked indicators of change, vague as they might be.

Well into the project, Jordan did detect a certain change in atmosphere or attitude at the Lab. She noticed that on (rare) occasions anthropological expressions and concepts appeared in conversation. It felt like awareness of both SlotC and her internal ethnography course rose. Previously, while there had been a general acknowledgement that yes, the social is as important as the technological in the Lab, this had not been expressed in official and semi-official channels, relevant to strategy. But now there were some indications of a new tone in the communications the Lab leadership prepared for presentations to the company leadership. At some point the Lab Director began to speak about ethnography as a competitive approach that distinguished his lab from others in Silicon Valley, something we felt was a notable advance in appreciation of design anthropology. Pictures from class sessions at UNT and the internal ethnography course began to appear in drafts of presentations. Similarly, once UNT students had completed their final report, the public relations function of the university began to take notice of the project (Bird 2015).

There is no way of assigning cause to these changes but as the SlotC project ended with a talk by Wasson at the Lab and a joint workshop on video analysis there was a definite shift from almost complete absence to an emerging awareness of ethnographic methodologies as a legitimate and potentially useful way to approach design issues. A bridge had been built, a divide made less deep.

BUILDING BRIDGES THROUGH METHODS

One of the distinct differences between the way industry and academia look at the world is in the methods they use to support their views. There is no part of their relationship in which the gaps are wider, the chasms deeper, the bridges more urgently needed than in methods. How did we encounter that in the SlotC project? While we did not expect eye-catching changes in the short period of this research, we hoped for indications of a softening of the boundaries, perhaps a gentle rapprochement. Or even a discussion thread that could lead into the future. Was there anything about the Lab and Class methodologies that might generate dialogue that might actually mitigate some of those disciplinary boundaries?

The core methodologies used by industry and academia are radically different. Lab research culture, as noted, was shaped by an approach that involves predetermined variables and statistical hypothesis testing of quantitative data, often experimental or survey based.

And then there was the simulator. Picture a group of roboticists and computer scientists working in a closed-off section of the Lab, programming algorithms that simulate the autonomous car of the future and test its behavior under various kinds of conditions.

For ClassPeople, the simulator was a mythical object, existing mostly on the level of rumors. They themselves used basic ethnographic methods for data collection and analysis with heavy reliance on human-centered participant observation. They relied on field- rather than laboratory studies and favored a grounded process of developing variables of interest within ongoing research rather than specifying them in advance.

The differences centered around researchers' self-image, as outside scientific observer for LabPeople vs. engaged participant for ClassPeople. Accordingly, Lab researchers saw their discipline as a deductive validating science while Class researchers felt part of an inductive exploratory or discovery science (Whalen and Whalen 2004). It was these almost religious differences between the two groups that needed to be bridged in some way.

Actually, as connectivity between LabPeople and ClassPeople increased and information about the other side became more available, the methodology gap became more apparent and more talk-aboutable. Conversations turned to examining epistemological differences and their effects. They asked: what does a survey get you in comparison to a field study? At the Lab, engineers attending Jordan's methods class were dealing with bias in interview and observational data and were particularly eager to understand how bias in ethnographic work compares to the biases inherent in surveys.

And they began to see the relevance of the ClassPeople's video analyses. LabPeople came to appreciate the fact that video eyewitness reports, translated into digital form in time-stamped post-event fieldnotes, could address emerging issues of quantification, data distribution, and identification of drivers' behavior patterns. One outcome of these discussions, sporadic and fragmented as they were, was a growing admission that the other side's methods might be useful under certain circumstances and for certain purposes.

Indeed, video documentation was the backbone of SlotC methodology and crucial both in analog form for questions of veracity (did they really do that? did they really say that?) and digitized as a large data base for the analysis of activity patterns and was of greater interest to the engineers than all other methods used in the SlotC project. Video, as an approximation to "reality" (even in its street meaning), allowed ClassPeople to substantiate their claims to "what really happened". It seemed LabPeople began to think of the recordings as a more "objective" data stream, maybe objective at least in regard to such things as what follows what, who talks to whom, or did the driver keep a hand on the wheel at what time, all highlighting the advantages of participant observation. LabPeople discovered one of the most important affordances of video is that it allows counting and often measuring (how far can a driver reach without looking?), providing behavioral details valuable for assessing drivers' activities quantitatively, which in turn can connect ClassPeople's ethnographic work with ongoing Lab research by providing input for simulations and experiments.

Interestingly and unexpectedly, out of these discussions came ideas about using social science methods for exploring the community of model-building computer scientists and roboticists hanging out with the mysterious simulator lurking in a locked back room in the Lab. It might be interesting to do a study, perhaps, in the form of the seminal SST (Social Science and Technology) Studies of scientific labs of the 80s, in order to better understand their worldview, including their disciplinary beliefs, attitudes and practices (Latour and Woolgar 1986).

The stridency around core disciplinary superiority decreased further. As the groups learned of the other's methods, it became clear that much of disciplinary ideology looked different in practice. For example, ClassPeople found out that Lab experiments sometimes did include communication between researcher and "subject", protocols were not always adhered to, and interview questions could be rephrased when common sense indicated that necessity. By the end of the semester, it had become increasingly clear that both sides use experimentation as a way to find out about the state of the world, and that the natural experiments of social scientists and the experimental investigations of the Lab engineers can deliver complementary information for sociotechnical issues. And so one of the major results that emerged from this project was a (somewhat) shared understanding that there are methods used by both sides that are sufficiently similar that they provide an opportunity for thinking jointly about some of the research and design issues the Lab faces. Any of their methods, on either side, could be an anchor point for a new bridge. But for success these bridges need to be designed and built in a socially engineered landscape of teaching and practice that brings people and ideas together.

CONCLUSION: A MODEL FOR SUCCESSFUL INDUSTRY-UNIVERSITY COLLABORATION

High tech research labs share with academic institutions a desire for some kind of close connection that would be beneficial to both sides. What would a model for successful academic/industry collaboration look like when it involves ethnographic research and the development of radically new technologies? Although there is a large literature on academic/industry collaboration, it mainly addresses rather different contexts and goals; and the overall conclusion seems to be that much collaboration is not particularly successful (Baba 1988; Freitas et al. 2009; Gulbrandsen et al. 2011).

Our paper contributes to the existing literature on university-industry collaboration in that there are few studies of culture change in either the industry or academic partners as a result of such engagements. Furthermore, there seem to be few prior studies of student projects for industry, even though these are quite common; most studies focus on faculty interactions with industry (Freitas et al. 2013; Perkmann et al. 2013; Wasson and Metcalf 2013).

The existing literature identifies strong personal relationships and trust as key factors for success. These relationships require mutual understanding and a common vision for the benefits that can be derived from the collaboration (Dowling 2015). Our experience agrees with this statement. The relationship between Wasson and Jordan was indeed central to the success of the SlotC project, because it formed the bridge that allowed ClassPeople and LabPeople to travel between two worlds.

Success in relationships between industry and academia has typically been assessed by examining the projects or products being developed (Gulbrandsen et al. 2011). But we would extend this model much further by arguing that the success of a partnership lies in the mutual culture change that is stimulated: the shifts in habitus that support building bridges between different disciplinary micro-cultures. These occur within each of the two groups when they come into conversation with each other that increases understandings of the other group's perspectives. Such cultural shifts can be strategically encouraged through the types of teaching activities portrayed in our paper.

With insights developed from the SlotC project and drawing on other collaborations in our experience, we would advocate reframing the whole concept of industry-university partnership from an instrumental focus on product outcome to a cultural focus on the bridge building, the mutual learning and exchange connections that can be encouraged in both groups. The pure outcome model tends to suffer from product idiosyncrasy and issues not only in impoverished relationships between the PIs but also from difficulties in transferring results. By contrast, in our culture-change model the very focus on the act of building bridges produces the means for ongoing collaboration and exchange.

When Jordan and Wasson first embarked on exploring the question of cars and driving from an ethnographic point of view, the objective was simply to explore ways in which ethnography and design anthropology could contribute to strengthening the human experience, the non-technology focused aspects of AV design. We knew that designing the driverless car of the future would be at the same time stupendously difficult but also fabulously interesting.

Meanwhile we have learned a lot – not only about what we might be talking about when we talk about driving now and in the future, but we also have come closer to specifying some of the crucial characteristics for a successful model for industry-university collaboration. In the end, we now have a better understanding of which issues are generic and which were idiosyncratic to our own situation and the particular people involved. And so we now know a lot about what we would do differently.

Therefore, the vision we propose for future academic/industry collaborations is to encourage further bridge-crossings as a main feature that can lead to culture change, an opening in the habitus of both partners. Such bridges may link universities and labs, as well as anthropologists and engineers, through class projects and other means. We would suggest that to cross the boundaries means establishing and supporting the growth of new micro-cultures that allow exchange and mutual adaptation leading to some form of mutual appreciation and even collaboration - an approximation to a shared state where the borders slowly become more permeable, where common grounds and a common language can be established.

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