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## Common Ground: How a Course Collaboration Between Engineering and Women's Studies Produced Fine Art

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## **Common Ground: How a course collaboration between engineering and women's studies produced fine art**

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### **Abstract**

The Mass and Energy Balances course at Smith College collaborated with the Women's Studies course on Youth Culture and Gender and with the feminist art collective subRosa to examine the relationships between cultures of production and the production of culture. The product of this collaboration was the interactive art installation "Can You See us Now? ¿Ya Nos Pueden Ver?" part of the Massachusetts Museum of Contemporary Art (Mass MoCA) exhibit "The Interventionists: Art in the Social Sphere."

The museum site itself once housed the Sprague Electric capacitor factory, but globalization pressures resulted in exporting production to Juárez, Mexico. Thus, engineering students conducted a life cycle assessment to quantify the environmental impacts of capacitor production in a globalized economy, while the Youth Culture and Gender class examined how conditions of life shaped by global production cycles link the cultures of young women in North Adams and Ciudad Juárez.

Students in both courses met occasionally throughout the semester to plan their contribution to the installation, which included fabricating art objects (including a representative circuit and capacitor) and producing a GIS map of materials flows in capacitor production. Each class had its own set of conventional deliverables including term papers, ethnographic research projects, ethics essays, and formal project reports.

The collaboration process is discussed, including how such projects are generated, how two distinct cultures of students can be brought to work productively together, and how to work well with off-site collaborators, which include a Sprague engineer as well as the art collective. Finally, reflections are offered about the impact of this collaborative project on students, the academy, and society.

### **Introduction**

In the spring of 2004, the Mass and Energy Balances course at Smith College collaborated with the Women's Studies course on Youth Culture and Gender and with the feminist art collective subRosa [1] to examine the relationships between cultures of production and the production of culture. The product of this collaboration was the interactive art installation "Can You See us Now? ¿Ya Nos Pueden Ver?" part of the Massachusetts Museum of Contemporary Art (Mass MoCA) exhibit "The Interventionists: Art in the Social Sphere." [2]

The project subRosa proposed at Mass MoCA involved asking “how female and feminized affective and material labor in the service, culture, and tourist industries sustains the economic basis of NA. We plan to map the economic and cultural effects that globalization and outsourcing of labor to other countries have brought about in towns like North Adams and Ciudad Juárez, Mexico.” [3] The group sought to present these ideas through the concept of a “forensic floor,” drawing on archaeological processes as a means to display artifacts in the exhibit. The forensic floor was chosen to emphasize the revelation of what is normally hidden in processes and products – particularly laborers, their histories and their lives. Unlike an anthropological project, the artists sought neither to remain neutral nor to have everything hang together in a coherent manner. At the same time, the artists did not sensationalize their subject in an effort to make it as accessible as possible to a broad range of people.

The project was a perfect meeting ground for all three groups, merging technology, culture, gender, activism, engineering, and art in multiple ways. The museum site itself once housed the Sprague Electric capacitor factory, but globalization pressures resulted in exporting production to Juárez, Mexico. This made it an ideal venue in which subRosa, a feminist art collective that focuses on interactions between technology and women’s bodies, could explore several ideas connecting technology, women’s labor, environmental degradation, violence against women, war, resistance, and refuge. Engineering students intersected most directly with the relocation of manufacturing from North Adams to several different sites abroad, and conducted a life cycle assessment to quantify the environmental impacts of capacitor production in a globalized economy. The Youth Culture and Gender class examined how conditions of life shaped by global production cycles link the cultures of young women in North Adams and Ciudad Juárez.

Rather than co-teach a single interdisciplinary course, this project represented a multi-disciplinary collaboration based in two distinctly different courses, each with its own purpose and content. Each class had its own set of conventional course deliverables including term papers, ethnographic research projects, ethics essays, and formal project reports. This paper discusses the project and its course settings, the development of the collaboration among the two courses, subRosa, and Commonwealth Sprague, the descendant company to Sprague Electric that currently manufactures capacitors in Juárez.

## Course Structure and Assignments

*Mass and Energy Balances.* Engineering 260: Mass and Energy Balances is a required core course in the engineering major, offered to second-semester first years at Smith College as an introduction to problem solving and ideas in thermochemical processes. In spring 2004 the enrollment was 38. The course is based on the introductory course in the chemical engineering curriculum [4, 5] using the Felder and Rousseau text [6]. Between two-thirds and three-quarters of class time was dedicated to problem-solving and the traditional course material. Problem sets were assigned on a weekly or bi-weekly basis, with conventional midterm and final exams related primarily to this material, comprising 50% of the grade.

An additional 25% of the grade and about one tenth of class time dealt with engineering ethics. Ethics topics were integrated with both the course material and the life-cycle assessment

project. (For a more complete description of the ethics work in this class see [7].) Students focused on writing an analysis of one of four case studies, using a draft model. Through peer editing students engaged all four topics. Case studies included:

- “USAWAY” – adapted from the Harris et al. text for capacitors, about American made vs. foreign made goods [8]
- “Whose property” – adapted from Harris et al. to relate to capacitors, about intellectual property, loyalty to company, honesty and communication, etc. [8]
- “Incident at Morales” – this multimedia case study thoroughly engaged process engineering, plant safety, environmental concerns, and border issues [9]
- “Automation and Globalization” – connected historical issues around automation (Hoosac Tunnel in North Adams) with present-day issues around Globalization (Sprague Electric Plant in North Adams). Students were asked to compare and contrast the engineer’s role in each social phenomenon and individual ethics in decision-making about participation in each system.

The final 25% of the grade and about one fifth of classroom time involved the application of mass and energy balance principles to the life-cycle assessment project in collaboration with the Youth Culture and Gender class and subRosa. The life cycle assessment project was adapted from Nair [10] and included two sets of deliverables – a written report due at midterm and a final written and oral report at the end of the semester. Objectives of the assignment included

- Application of course mass and energy balance ideas to a real-world problem
- Learning the principles of life-cycle assessment as an introduction to sustainability in design
- Developing information literacy skills including knowledge of different types of information, source validity, proper referencing of sources, use of research tools including library databases and catalogs
- Collaborating with a diverse group of individuals including professional engineers, professional artists, and women’s studies students, and within the class itself

The midterm deliverables included

- a. Description of what capacitors are and what they do
- b. Description of how capacitors are made (lifecycle)
- c. Flowcharts of materials flows around the world in capacitor production
- d. Annotated bibliography
- e. Reflection on source quality
- f. Criteria for evaluating environmental impact of capacitors
- g. Reflection on collaboration with YCG and subRosa. Initial design ideas for communicating anticipated results in the medium of an art installation

The final deliverables included

- h. A full quantitative life-cycle assessment of the environmental impacts of capacitor production
- i. Written and oral reports with all above parts, including a revisit of the criteria and reflections on the collaboration.

*Youth Culture and Gender.* At their most general level, cultural studies classes develop an understanding of how the seemingly banal and often invisible parts of everyday life cohere to form those bonds of commonality between people that we call “culture.” Cultural studies classes examine larger social relationships built through such sites as “common sense,” the wrestling match, national sentiment and femininity. Armstrong’s mid-level Women’s Studies course, called “Youth Culture and Gender” addresses the interplay of gendered expressions of culture by and about young people. The class begins with one central premise: “gender” as a social, political and economic process is always under construction and reiteration. “Gender” cannot be fixed in time, place, or context. In this sense, then, gender is a set of relationships that creates culture as much as culture sustains and produces gender. “Gender,” like “culture” and “youth” are not stable terms, but are relational ones that reflect and shape economic and political forces.

Students read abstract theorists of mass culture such as the mid-20<sup>th</sup> C. German philosopher Walter Benjamin, the girls’ cultural ethnographer Angela McRobbie, alongside ephemeral texts like graffiti, body piercings, zines and Brittany Spears. The course pushes students to examine how everyday culture is consumed, that is, where “youth” signifies a market niche for products. More important, the class emphasizes the possibilities of and limitations on young peoples’ active participation in cultural production. In light of these goals, subRosa’s art exhibition about femicide in Ciudad Juárez, Mexico and the cultures of resistance to globalization immediately hailed Armstrong as she developed the class research project in December, 2003 for a class to begin one month later.

The Youth Culture and Gender class is an upper-level elective in the Women’s Studies major at Smith College with a seminar-size enrollment in spring 2004. The students in the Youth Culture and Gender class explored the cultural lives of capacitors in North Adams, through their observation of young people in public spaces, such as bowling alleys, coffee shops, and in community youth groups. Their research asked how the knowledge of manufacturing continues to shape young people’s lives, even after the production of capacitors has moved out of the city. Students used their research to imagine possibilities of solidarity with young women and men in North Adams and their counterparts in Mexico. As the service economy of Mass MoCA has begun to revive hope for lost jobs and aspirations in North Adams, the students mapped the relationships and lives of the people behind both production industries, exploring commonalities and differences in the former culture of production in North Adams and the more recent production of culture.

The class was assigned several papers over the course of the semester. Some dealt directly with the collaboration, and some with key course readings. Students additionally were assigned a film project in which they produced their own video related to the themes of the course.

## **Project Process**

*Generation.* The Massachusetts Museum of Contemporary Art (Mass MoCA) advertised on its website its upcoming group show called “Critical Interventions” as a show highlighting politically engaged art in its widest sense. Armstrong, interested particularly in the connections between labor, gender, and art for her class, contacted the exhibit’s curator, Nato Thompson, who told her about capacitors and their role in North Adams and Ciudad Juárez. Thompson immediately saw the possibilities for collaboration, and passed Armstrong’s email to the subRosa collective.

Lucia Sommer became Armstrong’s initial contact with subRosa as they relayed still amorphous ideas about subRosa’s exhibit and the collective research project for Armstrong’s class. Together they began to conceptualize how the two projects intersected: both looked at how the macroeconomics of capital and labor flows produced a web that supported young women’s vulnerability to violence. Likewise, both took hope from young women’s cultures of resistance to that violence and the daily acts of building a better future. They also discussed how the capacitor factory in North Adams, Massachusetts that now housed Mass MoCA had moved to Juárez for its lower wages and benefits to workers and its lower taxes. What had been primarily family-waged, unionized men’s work in North Adams had become non-union young women’s work in Ciudad Juárez. We talked about those invisible emotional links of hope and despair between young women in both cities. The capacitor was one important link between countries, city residents, and workers, made invisible by the very flows of capital and production that linked them.

Within a week of her discussions with Sommer, Armstrong and Riley had a celebratory end of the semester lunch. Armstrong asked Riley to further explain how a capacitor worked, what it was made of, and the processes of its production. Armstrong told Riley about her plans to collaborate with subRosa, with little concrete idea how her mid-level cultural studies course would enrich their exhibit. It was serendipitous that Riley was looking for an appropriate object for her class’s life cycle assessment project to apply mass and energy balance principles to introduce concepts of sustainability. A capacitor was a simple enough device to provide a reasonable LCA project. The culture and gender questions raised in Armstrong’s course seemed an important dimension for the engineering students to take into account. Riley followed up a cursory lunchtime explanation with some additional research and soon after the lunch she sent more detailed notes to Armstrong via email. Armstrong similarly felt that the engineering questions Riley raised about capacitor production opened another dimension to any ethnography of culture her students would pursue in their collective research project.

So, in the elation of one semester ending and another yet to begin, we decided to give our very different classes a chance to develop their disciplinary expertise alongside another’s. We hoped the questions we heard each other asking would also spur the students to think more broadly in their research. We hoped by working alongside each other we could develop an educated respect for disciplines that so rarely talk to each other, even in the tools and skills they emphasize: Women’s Studies and Engineering. We saw our classes’ research projects as a means to develop multi-disciplinary skills rather than inter-disciplinary ones.

Despite her enthusiasm, it seemed to Riley initially that the structured demands of a first year engineering course would prohibit significant interactive collaboration, but as the creative

brainstorming process continued, it became clear that all three groups were willing to remain flexible and revise or expand both the project and the course settings to meet the needs of all groups, without compromising what each needed to accomplish. The flexibility of subRosa and both faculty involved was critical in creating an environment in which this project could become more than what any individual envisioned, and provide learning opportunities to all involved beyond what was imagined or anticipated.

Riley then contacted process engineer Ross Bentz at Commonwealth Sprague, a descendant company of Sprague Electric that maintains headquarters in North Adams though it has exported its production lines. Armstrong and Riley set up a meeting with the engineer to learn more about the history of the companies and their operations in North Adams and now in Juárez. Bentz provided Riley's class with critical data needed for the LCA and volunteered to visit the class and give a presentation on capacitor production. Bentz was also able to provide important historical information that was helpful for both the Youth Culture and Gender class and subRosa.

After meetings, phone calls, and several preliminary trips to North Adams Armstrong decided to frame the ethnography project on youth cultures around the capacitor. The ethnographic site would be North Adams, a risk in itself since the city was over an hour from Northampton and travel would require negotiating snow storms and icy roads. Her class began their research around the capacitor as it shaped the politics, history, economic prosperity and decline of North Adams. They learned anew how a capacitor worked and what raw materials were necessary in its production. They also learned, broadly, about the other companies that built capacitors around the world as well as the other businesses that remained in North Adams. From this wider research, they began to focus on particular sites for observation of how the capacitor animates the lives of young people in North Adams today. They chose public locations, like Mc Donalds, YMCA, Walmart and the local pool hall to witness where and how young people and capacitors met. They saw cell phones, check-out scanners, surveillance cameras, vacuum cleaners and music systems as they built new communities of support and broke off old lines of communication. Over the course of their assignments, the last being a three hour observation in their chosen locations, they mapped North Adams, a city depressed economically, with the highest rates of domestic violence, recreational drug use, and teen pregnancy in the state. They began to see how young people negotiated the city's changed prospects, both imbibing the hopes for a better future (represented by the new tourist economy of the museum), and the despair that this new economy could bring them the economic stability or consumer power of the past.

As the two classes began their research, Armstrong and Riley continued to stay in touch with subRosa and provide research updates. All of our insights, reports and contacts we passed on to subRosa. We continued to get reports from subRosa on the developing thoughts about their exhibit. Half way through the collaboration, subRosa extended what seemed an almost foolhardily generous offer: to design together a piece of their exhibit, a box in the "forensic floor" part of the installation. Neither instructor imagined at the outset that what began as background research would become actual production of fine art. We had only two months to think about how to translate our research and knowledge into visual and possibly auditory art.

*Joint work.* In addition to individual course assignments, the two classes met together several times for joint work. The first of these was a field trip to North Adams, MA. After a brief stop at the Hoosac Tunnel during which students learned about the social impact of the invention of the steam drill (first used during the tunnel's construction, and site of many worker races of manual labor against the steam drill, a direct comment on automation), students proceeded to North Adams. The Youth Culture and Gender class conducted field research including interviews and participant observation at various public locations in town. The Mass and Energy Balances course toured Mass MoCA, with particular attention to technology-related installations including an exhibit of prisoner's inventions and designs for an eco-utopia to replace the K-Marts that were closing around the country.

When Ross Bentz of Commonwealth Sprague visited the EGR 260 class to give a guest lecture on capacitor manufacturing, the Youth Culture and Gender class was invited to attend, and those students who were able attended. Similarly, when Faith Wilding of subRosa visited to give a guest lecture in the Youth Culture and Gender class, EGR 260 students were invited to attend. Additionally, Wilding visited the EGR 260 class and listened to student presentations on the life cycle assessment.

A Sunday afternoon meeting of both classes was held to allow students time to get to know each other, to work in multi-disciplinary teams, to share the results of their research (well underway by this time in the semester) and to brainstorm about possible contributions to the art installation at Mass MoCA.

Faith Wilding, during her visit to the Smith campus, hosted a second such meeting to discuss further the details involved in fabricating the design. After this meeting, a group of students from each class formed a team to fabricate the items in the machine shop. A subset of these students attended the installation and worked to install our portion. Some of these students were also able to attend the opening, which was held after final exams.

## **The Installation**

Students made three different contributions to the final installation. The primary contribution was in the form of research. The process and products from both classes' work helped subRosa formulate and crystallize concepts for the installation. The work from the Mass and Energy Balances course was used in several different ways. First, a GIS-produced map of global material and energy flows was hung in the installation (see Figure 1). Second, several elements from the first group brainstorming session were incorporated into a curated box in the "forensic floor" [note: explain concept of installation in background, also subRosa]. These included a spray-painted circuit diagram with capacitors symbolically represented, with black crosses drawn inside the capacitor, a representation of how the women maquiladora workers are remembered in Juárez. On top of this base was laid a fabricated capacitor, made with the actual casing of a Commonwealth Sprague motor run capacitor. A slit was cut in the casing to allow one to unfurl the capacitor inside (fabricated from a camping blanket and a window shade). On the silver spring-loaded tape were stenciled the words "we are not disposable" – a dual reference



to the environmental impacts of globalized production and to the use and abuse of women's labor in capacitor production (see figure 2).

*Student Response.* Students in both courses were troubled by some aspects of the project. Among the engineering students, the flexibility of the collaboration was disconcerting, as well as the level of work demanded of first years in the course overall. For most students this was the first quantitative engineering course and the first research-based project they had encountered, though not the first community-based project. Although the assignment was well structured with clearly defined deliverables enumerated above, the students continued to ask for more structure, which Riley sought to provide through direct interactions with students. The engineers were particularly challenged in keeping the big picture in mind throughout the project, and they often had trouble connecting the detailed life cycle assessment work with the larger questions posed by the artists. Students in both classes viewed the field trip and class visits favorably, but did not seem to fully appreciate the significance of the opportunity presented in fabricating art for a MassMoCA installation.

In the Youth Culture and Gender class, students were most challenged by the hands-on aspects of the project because of the ways in which the real-world experience intersected with the theory they had learned throughout their courses of study. Student ideas about class, culture, art, and gender were challenged in numerous ways, and it was difficult for those invested in theory to think in the nuanced ways that a gray reality can sometimes demand.

In a multi-faceted project such as this, different engineering students found different aspects rewarding or motivating. Some students were particularly excited about the art installation, engaging with Faith Wilding and subRosa because they recognized the rare opportunity to combine engineering with art. Other engineers appreciated the introduction to research the project represented, finding those skills useful in summer research jobs. Some engineers were motivated by the environmental aspects of the work, others by the connection to electrical engineering afforded by the subject of capacitors. Engineers (and Youth Culture and Gender students) who enjoyed shop work were able to engage with that part of the project.

## Reflections

There are a number of important observations to make about this type of collaboration. We will first discuss the pragmatic lessons learned and the challenges presented by such a collaboration, including the strategies we found most successful. We conclude with a discussion of the impact of this type of collaboration on the fields of engineering and women's studies, and on the academy.

This type of project requires coordination and resources. Both course professors put in extra time in meeting with our collaborators, organizing field trips, and the like. We were able to do this in part because of College resources at our disposal, including a budget to hire buses and pay other costs for the field trip, a machine shop with two staff members available to work with students, an extensive research library system and staff to support student efforts, phone, email, and transportation budgets to facilitate meetings on a regular basis, an electronic system

(BlackBoard) to connect students in each class and between classes to facilitate collaboration, and open-minded collaborators including the Commonwealth Sprague process engineer, the museum staff at MassMoCA, and subRosa. If any of our collaborators had lacked enthusiasm or been unable or unwilling to give generously of time, expertise, and information, we would not have been able to do this project so successfully, if at all. Our project built upon previous research on North Adams, the history of capacitors, the Sprague Electric Company, life cycle assessment, and capacitor manufacturing. Access to these materials was essential to our work.

Flexibility on the part of all collaborators was essential to the success of the collaboration. It was a leap of faith for each of us to be willing to give the project a chance. We went further than we imagined possible, but this required being open to traveling new roads and taking part in a cross-disciplinary conversation. The whole was indeed greater than the sum of the parts.

The model we used was multi-disciplinary rather than interdisciplinary. This project could not have happened otherwise. Riley was teaching a core engineering course and could not forego essential program courses to teach a collaborative elective, due to the teaching needs of the fledgling engineering program at Smith. Similarly, Armstrong was committed to teach a course on Youth Culture and Gender. Something would have been lost if we had team-taught a single course and tried to merge the curricula. Instead, we each taught our course in our discipline, and the students benefited from this disciplinary training. It grounded the project in two very different ways that were each important to the final result. We were essentially able to double the work the two classes accomplished by choosing not to share the work. Ultimately it engenders respect for the work and enabled us to leverage more support from the college.

This collaboration taught each of us as faculty new ways that our disciplines relate to one another. There are many ways in which our disciplines don't even know the conversations we are having with one another. Attention to these conversations is fertile ground for collaborative work and new insights into the academy, engineering, and women's studies.

There were key challenges related to helping the students understand the big picture and the ultimate goals of the project. There was an enormous cultural divide among students – not just in terms of what they learn, but how they learn, and what they value deeply. We were able to question students' assumption about each other, but in a single semester of limited meetings, we did not push this further. The Mass and Energy Balances class had the most trouble keeping the big picture in view. Without strong backgrounds in social science, students were hearing for the first time about gender, labor, and culture. To be confronted with the notion that engineers might participate in activities that exploit labor, exploit women, and exploit the environment was difficult for them as first years in particular. Students became mired in the details of the research and analysis for the life cycle assessment so that they forgot to ask larger questions about environmental impact, or to check how realistic their assessments were. Frequent in-class reminders and written reminders in the problem statement itself were not enough. It may be that first-years were not developmentally prepared for a task with so many different kinds of connections – to art, to culture, to social science, to current events.

Students in the Youth Culture and Gender class faced their own challenges related to confronting their own idealism by engaging in a project where the ethics are no longer black and

white, and connections in the real world among individuals and institutions are problematic. To examine the ways in which art itself, and social science research, can be exploitative was difficult for them.

The collaboration made these ideas come alive for students in ways they would not have otherwise. For the Youth Culture and Gender class, engineering is a discipline that has “doing” at its core. Many students of theory found their ideals were problematized by the real world. For the engineers, they were asked to take pragmatic skills to a large, almost utopian problem, bringing analytical skills to a problem as intractable as globalization. In both cases, students were confronted with their own privilege, and privileges associated with their chosen disciplines. Each had to ask, what is the artist’s/engineer’s role in globalization? Cultures of production and the production of culture proved equally problematic. We were able to shift the parameters of what it was possible to think about in each of our courses. To the extent we had an obligation at least to keep conversation lines open with the other class, our feet were held to the fire to take on the problems of our disciplines and our classes in a broader way, with more in mind.

This collaboration made each of us ask what we in engineering (or we in Women’s Studies) value from our students. What do we ask them to think about? What is a valuable lesson? In both courses, we found that process and modes of thinking were more important than particular course content.

For the academy, projects like these present multiple challenges. This project represents truly integrating engineering with the liberal arts, something Smith College is nominally committed to, yet this project did not receive recognition it deserved. This is in part because it represents a drain on resources and time. It is too much work, especially for junior faculty members. Project courses themselves have a strange relationship to the college, where some projects are deemed more worthy than others, based on town-gown relationships. Smith once had dedicated some staff time to support project courses, but this support was taken away during the semester in which we taught these courses. The impact of these courses is underestimated and misunderstood by the College, yet what we do goes to the core values of Smith. It raises central questions about what it means to do women’s studies at a women’s college, and what it means to do engineering at a liberal arts college.

For the individual instructor, this project was transformative, helping each of us realize in a new way the value of each other’s discipline and what is missing from a pure disciplinary approach to a problem.

The social impact of the project lies in the art itself, seen by thousands of individuals who will tour MassMoCA over the 10 months of the exhibit. This truly was an opportunity for engineering students to impact their world in an unusual way – by engaging with the public using the profoundly transformative communication medium of visual art.

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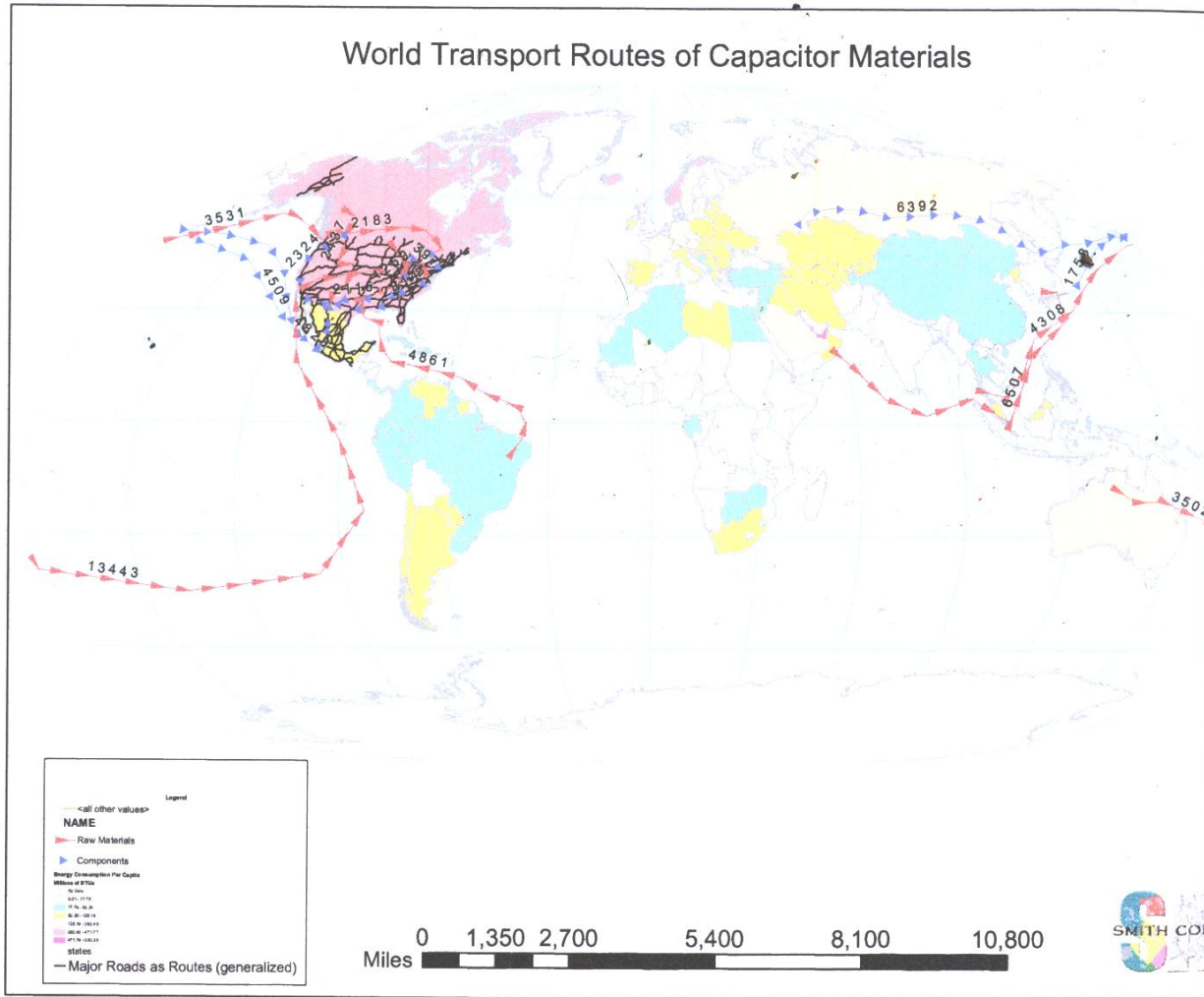
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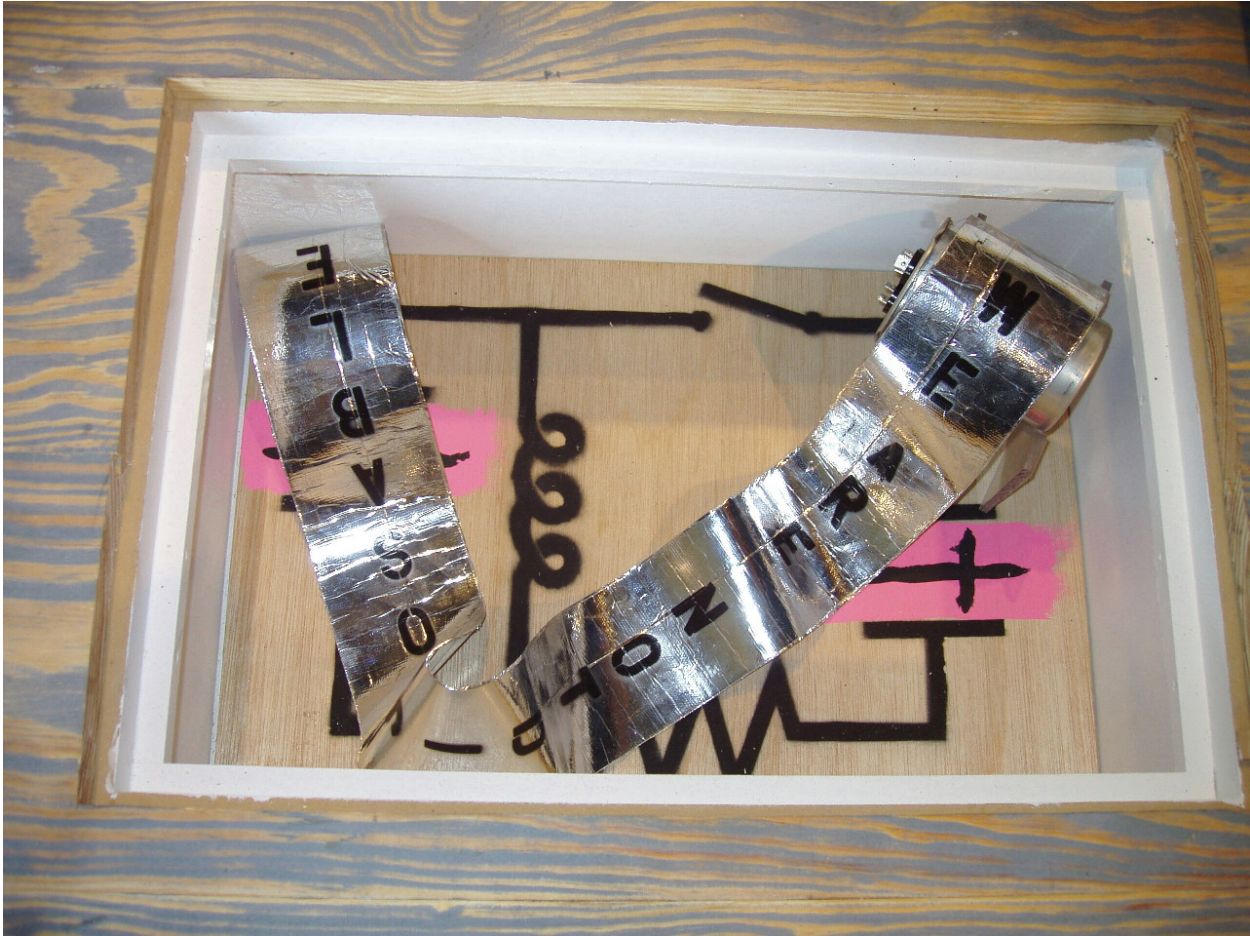


Figure 2. Smith curated box in the “forensic floor” depicts a circuit diagram spray-painted on plywood, with black crosses on pink backgrounds in the capacitor representing women murdered in Ciudad Juárez. A capacitor unfurls across the top reading “we are not disposable” a comment on the lives of women working in capacitor factories and the environmental impacts of capacitor production in a globalized throwaway society.