Supply Studies

Research Guide for Supply Chains and Global Logistics

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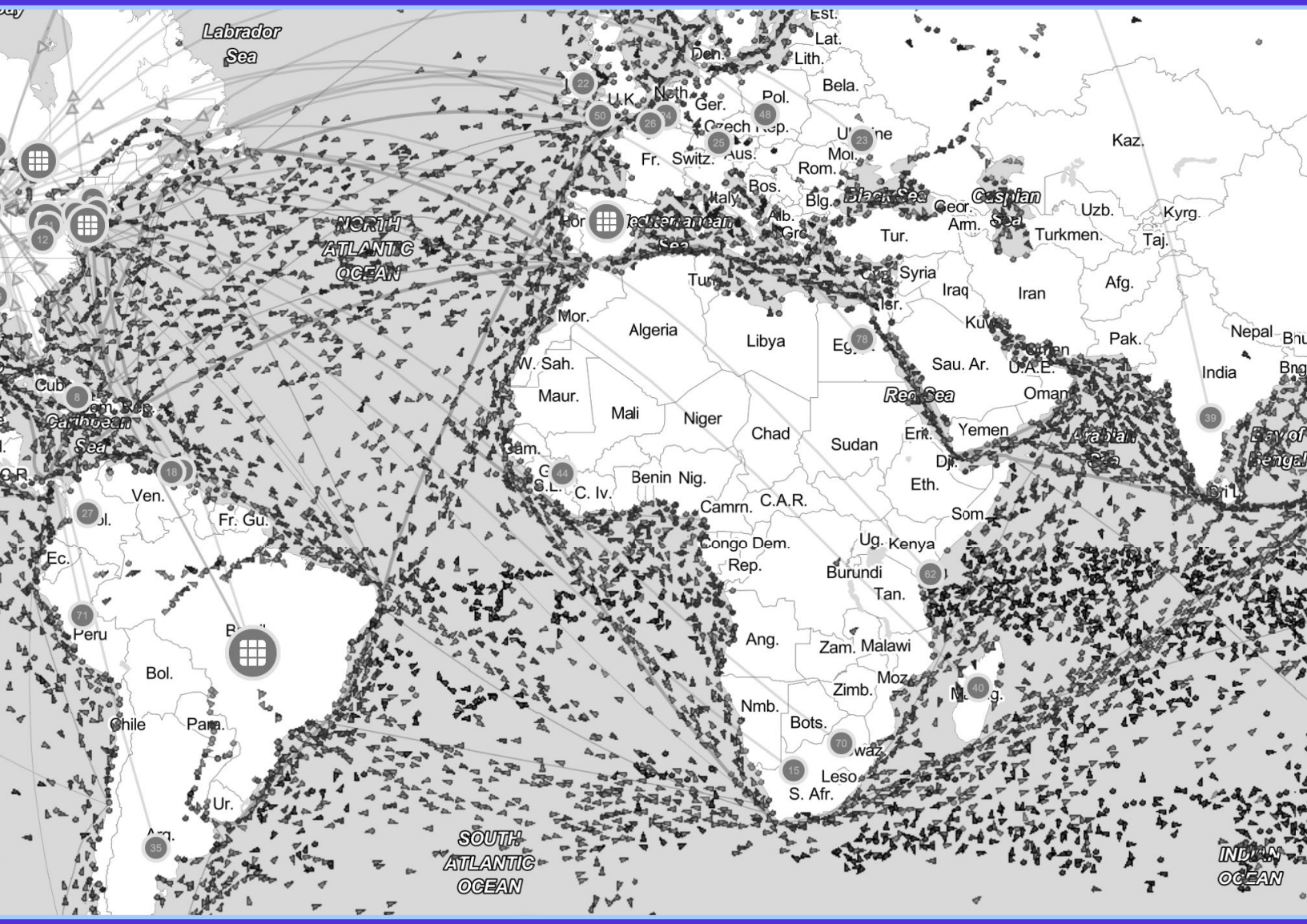

Manifest investigation showing global maritime movement.

February 2025

Table of Contents

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I. Introduction: What is Supply Studies?

The goal of this research guide is to support work in "supply studies," a field of research that is also known as the critical study of logistics. This is different from"critical logistics" or "critical logistics studies," which is language sometimes used by those who study logistics systems from an industry perspective. But despite the similarity in name and the partial overlap in topics, an important part of supply studies is that it is quite different from the work being done by supply chain managers, logistics professionals, and operations researchers. While supply studies might sometimes intersect with supply chain management and its related subfields, the emphasis for us is on the *critical study*—not the the importance—of logistical systems. Unlike industry professionals, we are not so much interested in optimizing delivery routes or studying inventory costs. Instead, we focus on documenting and analyzing supply chains to understand the impact that global logistics has on the organization of contemporary society. We are still open to their promises, in other words, but we are also well aware of their perils.

Broadly speaking, logistics is the enacting of complex organizational systems that coordinate the movement and transformation of things. Usually this means the manufacture and distribution of commodities. It's reach is so massive that we could even think of logistics of the "global operating system" for modern society.[1] Chua et al. argue that logistics has "evolved into a wide-ranging science of circulation," one which is "involved in planning and managing flows of innumerable kinds."[2] The supply chain is another name we give this organizational system and "wide-ranging science." It is a model for the sorts of logistical flows that now dominate our sense and experience of contemporary life.

In identifying supply studies as the "critical study of logistics" we follow similar motivations to those outlined by Chua et al. That is, that "supply studies" is about making sense of the opaque systems that shape everyday life, identifying the impacts and harms of logistical systems, and documenting the gaps between the potential of these systems and their often problematic realities. The overarching theme of our work, then, is the belief that "the way things work" in the society of the supply chain is rarely an inevitability and never a certainty.

There is another motivation for this work. Most of us who study supply chains are not just interested in documenting supply chains or telling the history of how logistics has shaped modern life. We also want to understand

> This focus on supply chains—or supply studies, as some have called it—is rooted in the knowledge that our relationship to technology cannot be understood purely in terms of how we make use of it. Instead, the approach is premised on investigating the metals, refineries, factories, shipping containers, and warehouses that not only manufacture and deliver our electronics, but also form the infrastructure that organizes our society. Supply studies attempts to distill and make legible these global networks, whose complexity obfuscates the harm they cause. It provides a crucial lens for understanding the real origins, and the real impacts, of our devices.
>
> Jackie Brown, "Source Material" (March 2021)

how we can intervene in the operation of these systems. We want a world without devastating consequences for the environment, where workers are given agency and opportunity free from the threat of human rights abuse and economic injustice. By studying supply, we are looking for opportunities to change, challenge, and circumvent the current pattern and practice of logistics in the hope of building a more just future for supply.

Making Sense of the Opaque Systems That Shape Everyday Life

The emergence of supply studies overlaps with an increased understanding of globalization's impact on the manufacture and trade of consumer products. A brief survey of the production processes behind everyday items on a desk—a laptop, a tissue box, a glass of iced coffee—is effectively a world tour of key commodities: minerals, lumber, fertilizer, coffee beans, petroleum (for making plastics), and more. Through these relatively banal items, objects that might otherwise be taken for granted in day-to-day life, the person sitting at the desk is connected to places they will never see and people they will never meet, whole lives and worlds that one would never be able to fully comprehend just by looking at objects sitting on that desk. For many supply studies researchers, there's an intrinsic curiosity underlying their work: why wouldn't we want to know about the grand tapestry of global production making this quotidian workday possible?

In some sense logistics is fundamental to human existence. It is present when we shop for ingredients in preparation for a meal, or when we pack our bags for a simple outing. But the kind of large-scale logistical systems supply studies researchers are interested in operate in support of and via capitalism—an economic system that's about moving around (and multiplying) money and commodities. Anna Tsing goes so far as to suggest that we are now in an era of "supply chain capitalism," where commodity production is now "based on subcontracting, outsourcing, and allied arrangements in which the autonomy of component enterprises is legally established even as the enterprises are disciplined within the chain as a whole."[3] A critical approach to logistics begins with the understanding that capitalism is not fixed or unchanging, and that this new form of "supply chain capitalism" is not, in other words, an inevitable evolution in our way of organizing society. The current articulation of logistics is a system constructed by human beings, rather than a fundamental phenomenon of human existence.

Identifying the Harmful Impacts of Supply Chains

In the United States, cost cutting has been the key motivator for shifting (as Anna Tsing says, "outsourcing") many of the stops on the supply chains to other countries. Often, those cuts have come primarily from reducing wages. By manufacturing countries with weaker global trade power, with less established trade and/or labor unions, or by taking advantage of more relaxed (or less reliably enforced) environmental or workplace safety regulations, companies can make something that most consumers will regard as a reasonably equivalent (if not perceptually identical) product with less overall manufacturing cost. While in the short term this makes for cheaper products and accelerated commercial activity, the long-term effects can be devastating for communities and ecosystems—for both the country doing the outsourcing and the country where the products are now made. Within the critical study of logistics, many researchers work towards accountability for the harms that occur across the supply chain, often looking to support organizing efforts by workers and communities hoping to change their conditions for the better.

Documenting Gaps Between Promises of Logistical Systems and Their Practice

While the minutiae of supply chains are often opaque to the general public, all industries (including logistics) tell stories about themselves. These stories constitute a kind of "logistical imagination," a way of seeing the world through a logistical lens. Sometimes this is explicit, as it is in the kind of marketing materials put out by professional logistics firms. UPS's "We Love Logistics" campaign, for example, takes television viewers on a worldwide tour of deliveries set to the tune of Dean Martin's "That's Amore."[4] Or we could consider the commercial released by Maersk (a major shipping company) in November 2020. This spot featured an incongruous rap about the importance of working "Together, All The Way" in support of global supply chains, with its message narrated by a diverse cast of attractive performers moving through sets designed to vaguely resemble actual logistics environments. Here cardboard boxes are carried in dance numbers, artfully arranged with letters painted to spell out the word "dependable."[5] The message of the commercial is that Maersk makes a connected, creative, and collaborative world possible through its efficient movement of commodities. The timing of its release was significant. After months of stories about supply chain disruptions and crises, Maersk wanted to convey a message that the future looked bright for supply chains, and that they were the company that helped make this bright future possible.

Advertisement from UPS "We Love / Heart Logistics" campaign (2010-2015).

But the story of the supply chain is not limited to the marketing message of logistics companies. They are also narrativized in the internal techniques and technologies used to maintain them. Supply chain software is as much a storytelling method as an advertisement: both simplify global processes into abstracted frames that endeavor to make supply chains appear logically and efficiently managed. In an essay for *The New Yorker*, supply studies researcher Miriam Posner describes learning to use SAP SCM 7, a popular supply chain management software system:

> In such a system, a sense of inevitability takes hold. Data dictates a set of conditions which must be met, but there is no explanation of how that data was derived; meanwhile, the software takes an active role, tweaking the plan to meet the conditions as efficiently as possible. sap's built-in optimizers work out how to meet production needs with the least "latency" and at the lowest possible costs…The consequences of this relentless optimization are well-documented. The corporations that commission products pass their computationally determined demands on to their subcontractors, who then put extraordinary pressure on their employees.[6]

Anyone who has worked in an office environment likely understands that logical, competent systems in business settings are few and far between. For all the efforts employed to create streamlined systems or efficient workflows, getting things done always produces "friction"—"contingencies, gaps, and slippages" between people, places, and things.[7] A critical approach to logistics takes interest in this gap between the ideals of system designers and supply chain managers and the day-to-day realities of global commerce.

A Brief History of Logistics and Supply Studies

The word "logistics" as it's used today can be traced back to the Napoleonic Wars of the early 19th century. Etymologically, it derives from a Greek term for calculation. Its adoption for military use was related to that sensibility—it was a way of describing the working out of how to most efficiently move, feed, and house troops. As Baron Henri de Jomini observed in his 1838 treatise on military theory, "Logistics is the art of moving armies. It comprises the order and details of marches and camps, and of quartering and supplying troops; in a word, it is the execution of strategical and tactical enterprises."[8] As war became increasingly mechanized in the 20th century, logistics became an ever more urgent concern. It appeared in business operations more regularly after World War II, when many of the soldiers who managed the complex logistical operations required by that conflict adapted the lessons they had learned to peacetime. But this was only a limited enactment. Management guru Peter Drucker famously declared in 1962 that American business knew as much about the "dark continent" of distribution as Napoleon's contemporaries knew about the interior of Africa—"we know it is there, we know that it is big, and that is about all."[9] It wasn't until 1982, that Booz Allen consultant Keith Oliver coined the term *supply chain management* to describe managing the disparate functions of supply "as though" they were a single entity.

> Part of the work of historians engaged in the critical study of logistics involves situating systems enacted before the formalization of "logistics" into a broader genealogy of logistical practices. The supply chain has not just one beginning, but many, and each contributes something to our understanding of its contemporary circumstance.

While supply chain management may have a relatively recent origin, as long as there have been globally distributed production networks there have been people critically interrogating them. British abolitionists in the 18th century, for example, organized boycotts of what they called "blood sugar"—West Indies-produced sugar produced through the use of slave labor. The transatlantic slave trade itself has been described as one of the birthplaces of modern logistics. As Stefano Harney and Fred Moten write, more than little poetically, "Modern logistics is founded with the first great movement of commodities, the ones that could speak. It was founded in the Atlantic slave trade, founded against the Atlantic slave":

> From the motley crew who followed in the red wakes of these slave ships, to the prisoners shipped to the settler colonies, to the mass migrations of industrialisation in the Americas, to the indentured slaves from India, China, and Java, to the trucks and boats leading north

> across the Mediterranean or the Rio Grande, to one-way tickets from the Philippines to the Gulf States or Bangladesh to Singapore, logistics was always the transport of slavery, not 'free' labor. Logistics remains, as ever, the transport of objects that is held in the movement of things. And the transport of things remains, as ever, logistics' unrealizable ambition.[10]

Anti-Saccharrites (1792) by James Gillray depicts George III and his wife, Charlotte drinking tea without sugar and urging their daughters to do the same.

Over the past fifty years, logistical systems have become increasingly complex and commonplace. The mid-twentieth century development of containerization—shipping products in interchangeable vessels rather than as bulk goods—enabled streamlining and automating port operations, changes which transformed the speed of global trade. International trade agreements like NAFTA allowed companies to move manufacturing to new locations around the world. These shifts were not without scrutiny, and while these new tools and technologies made it possible to speed up supply chains, it has also made it possible for more and more people to document and share information about the various environmental and social impacts of this new arrangement. Stories about the supply chain's environmental impacts, the risks for health contamination in everything from medicine to children's toys, and the sometimes brutal and oppressive labor regimes used for producing the fundamental components of the highest of technologies have become commonplace. But those stories—these investigations—represent years of work on the part of journalists, activists, and scholars. It isn't always easy to get a good look at something as large as the supply chain.

If you're reading this guide, you probably aren't actively involved in supply chain management or coordinating complex logistical networks. More likely, you're reading this because you're interested in understanding a particular supply chain but, as an outsider, you aren't sure how to get the information you need. The next few sections of this guide get into ways of thinking about and doing logistics research (the logistics of the critical study of logistics, so to speak). We start with **Research Frameworks**—the methods that can be used to conduct supply studies investigations, including a sample investigation. We then examine the **Techniques and Data Sources** that these methods rely on, before looking at some **Case Studies** of existing supply studies investigations. In **Manifest and Other Tools** we talk about Manifest, our platform for documenting and analyzing supply chains, while describing some other possible tools of interest to investigators. Finally, we present a sample **Curriculum and Pedagogy** for learning more about the various topics relevant to supply studies research.

Notes

[1] Matthew Hockenberry, Nicole Starosielski, and Susan Zieger, eds. *Assembly Codes: The Logistics of Media* (Durham: Duke University Press, 2021), 1.

[2] Charmaine Chua, Martin Danyluk, Deborah Cowen, and Laleh Khalili, "Introduction: Turbulent Circulation: Building a Critical Engagement with Logistics," *Environment and Planning D: Society and Space* 36(4) (2018): 617-629.

[3] Anna Tsing, “Supply Chains and the Human Condition," *Rethinking Marxism* 21(2), (2009): 148–176.

[4] UPS, “We Love / Heart Logistics” Campaign (2010-2015).

[5] Maersk, “'Together, All The Way' – An Anthem” (2020).

[6] Miriam Posner, "The Software That Shapes Workers' Lives," *The New Yorker* (March 12, 2019).

[7] Anna Tsing, *Friction: An Ethnography of Global Connection* (Princeton: Princeton University Press, 2005).

[8] Antoine-Henri Jomini, *The Art of War,* G.H. Mendell, translator (Kingston: Legacy Books Press, 2008).

[9] Peter Drucker, "The Economy's Dark Continent," *Fortune*, April 1962, 103.

[10] Stefano Harney and Fred Moten, *The Undercommons: Fugitive Planning and Black Study* (New York: Autonomedia, 2013).

II. Research Frameworks

Most supply chain investigations involve attempts to understand the complex network of extraction sites, processing facilities, interchange hubs, distribution and warehouse facilities, and retail sites that constitute the supply chain of a contemporary product. In other words, they are looking to trace the path of the product from its base materials to its manufacture, shipment, storage, and—ultimately—sale. In some cases, these investigations follow the product "downstream" along the supply chain. As Mario Rautner writes, "if an investigation starts at a mobile phone assembly plant suspected of using child labour, it will most likely continue downstream to the brand that sells the mobile phones." But it may also move "upstream," "to the origin of the plastics and metals used in the phones' manufacturing process. The focus here will be to expose illegal and unethical practices of exploiting children to produce that phone." This could also be the case in an investigation of a company establishing a manufacturing plant in a town whose residents want to find out if the materials entering "are of controversial origin."[1]

In either case, once investigators identify a starting point, they usually try and follow the path along the supply chain, attempting to gather the evidence that connects each step of a production process or transportation pathway to the one that comes after it. While this may seem clear cut, this research can be surprisingly nonlinear (there are "many forks in the road" when it comes to supply chain investigations). It may also require a wide variety of different tools, techniques, and methods. Investigators may go from tearing apart products and subjecting components to chemical tests to interviewing workers at factories or warehouses. They may turn to corporate documents related to supply chain operations or consult governmental reports on trade patterns and zoning requirements. And this is all in the hopes of establishing just a single link in what is—even for the simplest of products—a massive and meandering supply chain.

For most researchers, the initial goal of the investigation is to document the "complete" supply chain of a product, or to offer a full and comprehensive examination of a trade network. But in practice this goal is usually an unattainable one. Supply chains are not only complex—enrolling hundreds of sites and thousands, if not tens of thousands, of people—they are in a constant state of flux. Parts are revised, suppliers come and go, workers are moved from one work station to the next. The term "supply chain" is misleading. These are supply *networks*. Each node might connect to multiple pathways, making it difficult—if not impossible—to establish which company may have manufactured a particular part, or which distributor delivered it to the next factory. In fact, what we call the same products are often made at multiple factories in radically different places—with both material differences in their constitution and wide-ranging variability in their social and environmental impacts.

But even if we ignored these challenges, should we set out in the hope of telling the whole story of the supply chain? Even the companies that make these products and the carriers who move them might only know the first tier of the supply chain. In all their piles of documents and pages of plans they may only have a list of the fulfillment centers and distribution hubs that they deal with directly. In rare occasions the most conscientious

companies might know the second tier (their suppliers' suppliers, in other words, the hubs connected to *their* hubs). But what could they know about the third, or the fourth? The reality of the supply chain is that even the companies don't fully understand them. Few logistics providers know the entire scope of their operations. In large part, this is by design. It is a feature of global logistics, not a bug. Supply chains work by abstracting out these details, replacing knowledge of real people and places with interfaces designed to sort only by standard and price. From a company's perspective, the entire point of the supply chain is that they don't have to worry about their suppliers' suppliers. That's someone else's problem. And for supply studies researchers, that is another problem altogether.

Planning the Investigation

Investigators who are still interested in documenting an entire supply chain look might be advised to begin by scoping the number of tiers they will follow, and then setting up a plan to move on to meticulously documenting their product's parts, the suppliers responsible for those parts, and so on through the successive subassemblies (and raw materials) that make up the chain. For the rest of us, the vast reach of the modern supply chain means that most—or at least the most effective—supply studies investigations focus on telling *partial* supply chain stories. With this in mind it makes sense for a supply studies investigation to begin by reflecting on the goals for the investigation and how the investigator can best achieve those goals.

What is the goal of the investigation? For any supply studies investigation it is crucial to begin by identifying the primary goal and prioritize any related subgoals. Start by asking what supply chain story you are most interested in telling. Are you interested in understanding the impact of a logistics company on urban spaces? If so, you might begin by selecting a single company like Amazon, or looking at one of their competitors like Walmart or Home Depot. If you decide on Amazon, and your primary goal is investigating Amazon's impact on urban spaces, this helps identify your primary object of interest. In this case you are probably going to be looking more at things like warehouses and distribution centers, for example, than factories for Amazon Essentials products or the company's small retail footprint. It also helps specify the sort of data you will be interested. Here, you are probably going to interested in data like facility size, employee numbers, cost, and so on. You might also be interested in interviewing Amazon warehouse workers, drivers, community residents, and governmental officials. The goal of the investigation helps define this focus. If you are interested in something else—the environmental impact of a mobile phone, for example—you might not be tied to a specific company, or even a specific set of manufacturing facilities. In this case you might be more interested in looking at geographies of resource extraction and measures like embodied energy costs. You might also be interested in doing a deep ethnographic investigation of a particular community impacted by the mobile phone supply chain, or connecting with a wide range of actors across the product sector.

What time period does your investigation focus on? We sometimes talk about supply chains like they are fixed things, but the supply chain is an instance—the singular crystallization of all the people and places, machines and materials, that go into the assembly and delivery of a particular thing. To write about the supply chain is to write about thousands,

if not millions, of these moments. If your investigation is focused on contemporary supply chains, what years are "contemporary"? This is sometimes a factor of data availability (there is often a response lag for certain data sets). Historic investigations might find it valuable to bracket their research by significant events, either looking at useful breaks in the broader historical context (the start of a war or the passage of a pivotal law) or by looking at specific changes that would have had an impact on production and distribution (such as a corporate merger or a new invention coming to market). The U.S. entry into the Second World War, for example, addresses both of these. Not only is it a significant historical moment, it forced companies to shift production toward war efforts and radically changed the prior pattern of consumer behavior. Even smaller, more localized events (like the spinoff of electrical production for Western Electric in the 1920s), can mean significant changes for supplier relationships between two time periods.

What is the scope of your investigation? It is important to set the scope of an investigation before the research process begins. Supply studies investigations can quickly become unwieldy, and setting a clear scope helps keep the investigation focused. You should decide if you are focused on a single company or a sector, for example, and if you are limiting yourself to a broad geography (like “Europe,” “the United States,” or “China”) or if you are narrowing in on a single state, province, or region. If you are doing a contemporary investigation, how many years back will you look, and how current do you want (or need) your information to be? If you are doing a historic investigation, what pivotal events help to constrain your period of investigation? We can't look at everything. Do you need to tell the manufacturing story of every part of an object, or would a single part be enough? Does it matter if it's focusing on a particular company? How general or specific, in other words, can you be—and about what?

What are your sources of data, and what are the limitations of those sources? A company like Apple publishes a list of suppliers for all the products it makes, but it doesn't differentiate them by product. If this is the only data source you are working with, telling the story of “Apple's supply chain” becomes much easier than telling the story of the “iPhone supply chain” (let alone the “iPhone 15 supply chain”). It is often the case that the kind of data you have access to will tell you what kind of investigation will be most effective. This doesn’t mean you can’t keep looking for more data, but this can be balanced with what your goals actually require. While contemporary investigations may be able to generate more data (through interviews, visits, etc.), historic investigations may be forced to contend with the limitations of their archives. While production and distribution became increasingly systemized over the course of the late 19th and early 20th century, for example, many of the operational records that would be most useful in reconstructing these processes are poorly represented in the archives. There isn’t any time travel—if its not there, its not there. Of course, it may be difficult to know in advance what the range of available data sources might be. This is just a pre-research estimation, and all investigations will change and evolve as the research process unfolds.

How will you organize your data? At its simplest form, a representation of a supply chain might just be a list of nodes. But what do those nodes, themselves, represent? They could be suppliers or factories—or they could be some other kind of locations. Making organizational choices about the “building blocks” of your investigation and the output you might expect can be useful for understanding the ideal scope and data sources of your investigation. Specifying that one of the primary outputs of an investigation will be a map of "factory locations,” for

example, where every node represents a site of production (a factory, workshop, or assembly site), sets clear expectations on the kinds of data sources (and data) which will be required. If that investigation instead focuses on nearby communities—the apartments rented by workers, the design offices of the company that led to the creation of the supply chain, and so on—this would require different data, different methods, and be subject to different limitations. Of course, there isn't a single approach that works for every project. For some investigations, focusing on facilities or geographic sites as “building blocks” makes sense. Other projects might instead focus their attention on individual actors (from CEOs and VPs to factory and warehouse workers), or they might focus primarily on materials (like wood or lithium). They might even focus on entirely abstract ideas (where does the product's "modularity" come from, for example).

Getting Started on a Supply Study

One of the biggest challenges for researchers coming to a supply studies investigation is how to get started. How do you go about finding information about where materials come from? How do you know what the sites of production and distribution are? Of course the answers to these questions can vary considerably from project to project. For historic investigations, these can be incredibly specific—with the geographies and data driven primarily by the availability of archives. For more contemporary projects, investigators might benefit from documents detailing some relevant infrastructures of production or distribution, or they might look to tear-downs that reduce products to their constituent components (providing initial information on suppliers, part numbers, and other identifiers). They might read articles that provide descriptions of the underlying raw materials necessary for a product, or start with prior interviews or investigations concerning similar or related projects. In other chapters we will provide more detail on specific kinds of data sources—but for now we want to focus on what the investigation “looks like.”

Supply chain investigations come in different forms. They might serve a journalistic interest—sharing an understanding of the supply chain or revealing some hidden impact to a broad public audience. They might be historical investigations intended for academics. They might be activist interventions which call attention to (and prompt action on) social injustice or environmental degradation. It may be helpful to look at the general, though not mutually exclusive, qualities supply studies investigations might possess.

Investigation Scope

Complete or Partial Investigations - In all but a few circumstances, a "complete" investigation is largely an aspirational goal. Even for the most powerful companies on the planet, it is rarely possible to produce an accurate accounting of a supply chain. The supply chain is an object of unknowing, a tool of abstraction. Its entire purpose it to shield successive tiers from the

Every supply study has a particular scope, a primary focus and a set of limitations that define it. This does not necessarily imply a weakness in the investigation, these constraints can be a powerful strength—honing the outcome to a particular purpose.

complex exchanges required to produce one part or to perform one process. Supply chains shift and churn constantly. Companies come and go, designs change in subtle, rippling ways, as the people who mine, assemble, or ship them come off the line, climb out of the mines, or turn off their trucks for the night.

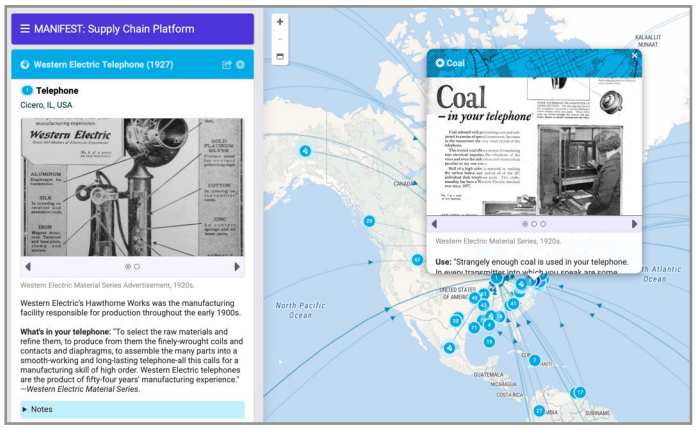
Given this, most investigations are partial—whether they want to be or not. They represent just one of many possible stories one could tell about a given supply chain.

Contemporary or Historic Investigations - All accounts of supply chains will, in a certain sense, become historic. But we generally distinguish between those that use historic research methods like archival research, and those that use research methods only available to contemporary researchers (such as ethnographic investigation, interviews, and similar approaches). Still, there is not always a clear distinction. Some historic supply studies might rely on "oral histories," for example, that can seem similar to contemporary interviews. Corporate records and supplier reports available on websites might be from the current year or they could be from ten years ago—does using them make this a "historic" investigation? One other way of making this distinction might be that, for contemporary investigations, new data is still be creating—new reports, new employees being hired, etc. For historic ones, new data *might* be discovered, but the supply chains that produced that data have long since run their course.

Investigation Presentation

Most investigations will produce some sort of output. This might be a magazine or newspaper article. It might be a book. It might be a video or podcast episode. It might be an interactive visualization or infographic. Many investigations will yield multiple deliverables.

Narrative (Qualitative) Outcomes - All supply studies are narratives, insofar as they are all stories about supply chains. But some are more narrative than others. Investigations like the historic Manifest of the Western Electric Telephone (https://manifest.supplystudies.com/manifest/samples/western-electric/), for example, include rich descriptions of extraction and production sites, with quotes and comments from sources like companies or journalists about the various materials and suppliers once involved in the telephone's assembly. They could also include images (sometimes a lot images) or other media. These investigations bring their relevant nodes into focus—revealing the kinds of operations, geographies, and people they represent.



Narrative Manifest of Western Electric Telephone, 1927.

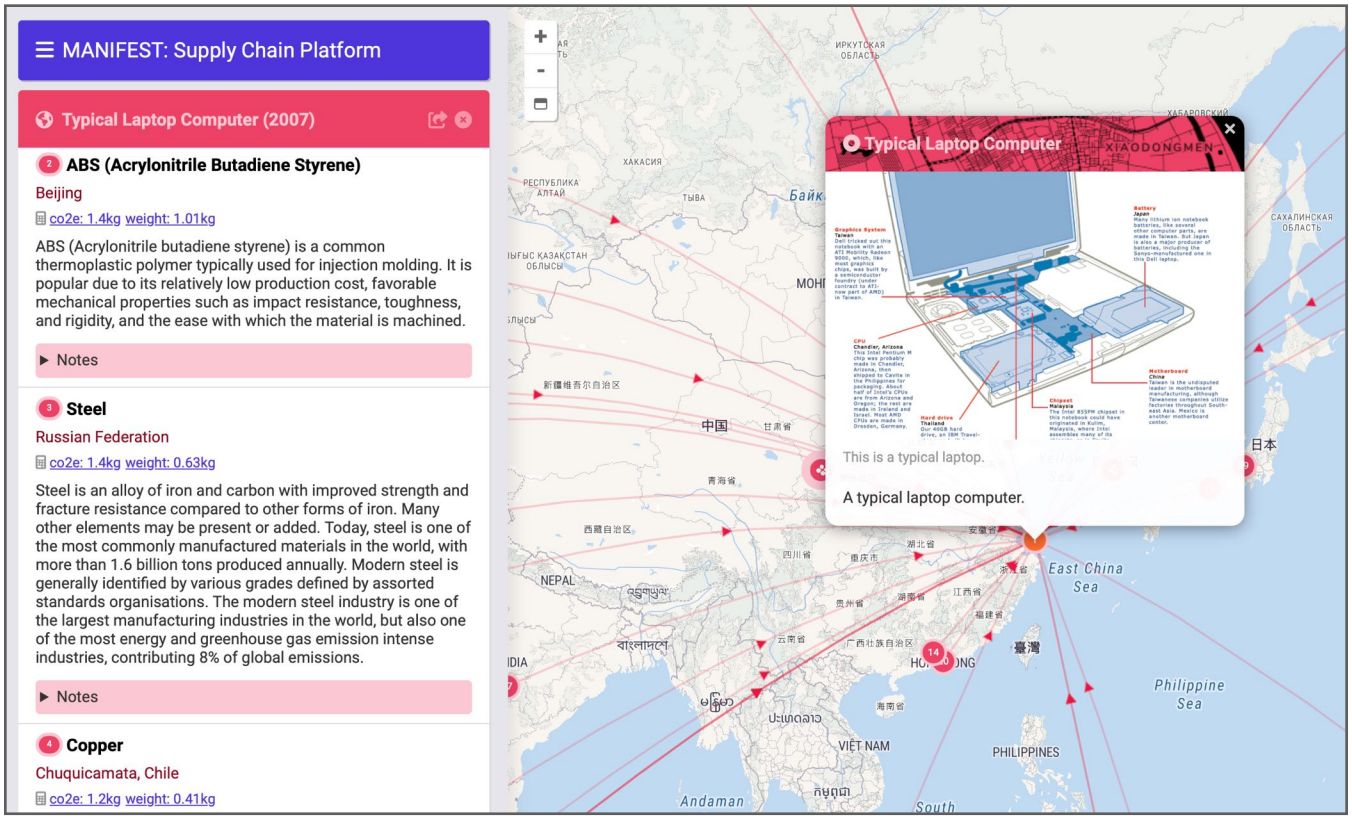
Quantitative Outcomes - Some investigations, like the Manifest of global Vinyl Pressing Plant facilities (https://manifest.supplystudies.com/manifest/samples/vinyl/) focus on quantitative measures. These might be things like the square-footage of facilities (of, for example, Amazon Fulfillment Centers) or the number of people (workers, consumers, etc.) enrolled at

a given site. They might also look at the impact of various sites or operations in terms of their CO2e, electricity usage, water waste, and so on. The goal of these investigations is usually to allow readers to understand comparisons being made across specific measures, or to describe patterns in large sets of otherwise unapproachable data points.

Investigation Type

Component/Constitution Investigations - Sometime just knowing what materials, sites, or people make up a particular product or part can be a valuable exercise. So too, can the general material demands of a product category (the "typical" materials used to make a car, a tablet, or a phone, for example). An component/constitution investigation, like the Manifest of a Typical Laptop Computer (https://manifest.supplystudies.com/manifest/samples/typical-laptop/), is a kind of "ingredients list" that provides readers with an understanding of what is inside a product and where it comes from—and without all of the specific steps, or exact connections, required for the complete supply chain. Sometimes useful (if general) measures, such as carbon footprint, water usage, and so on, might also be included, and this can be useful in communicating the expected impact of a particular consumer choice, even for a general product category.

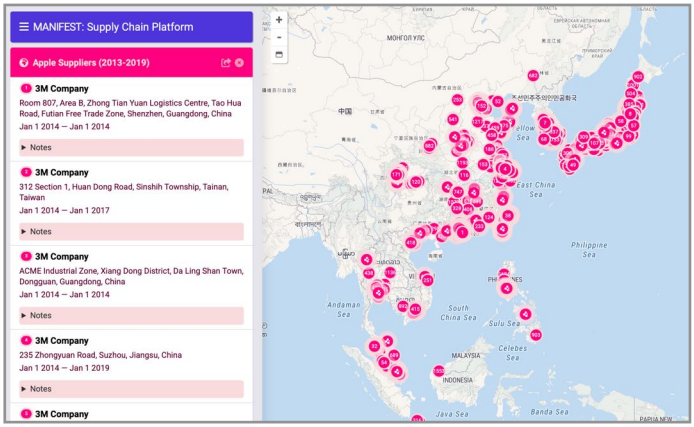
> Different kinds of supply studies might have different focuses—an emphasis on certain kinds of details, specific starting points, or ideal outcomes.



Manifest of a Typical Laptop Computer from 2007, based on Dylan Tweney's 2007 PC Magazine article "What's Inside Your Laptop?" (https://dylan.tweney.com/2007/03/13/whats-inside-your-laptop/) - https://manifest.supplystudies.com/manifest/samples/typical-laptop/

Upstream/Downstream Investigations - This type of investigation focuses on one end of a product or product category in particular, either raw materials (the bottom—upstream—of the supply chain) or top-level manufacture, final assembly, and retail (the top—downstream—of the supply chain). See, for example, the Champion Petfoods Manifest (https://manifest.supplystudies.com/manifest/samples/champion/) or the Nissan Supply Chain Manifest (https://manifest.supplystudies.com/manifest/samples/nissan/). This is often because it is the middle of the supply chain—the companies providing the countless parts, various manufacturing processes, etc.—that is more difficult to pin down. Information about the top of certain supply chains may be surprisingly accessible (for example, a list of something like H&M Retail Locations: https://manifest.supplystudies.com/manifest/samples/handm/). Conversely, the bottom of the supply chain may have already been examined (think of the work done by activists and NGOs on companies like Apple, Amazon, and Nike). But this end often remains somewhat more piecemeal and partial. For while it may be possible to know that a particular product requires certain metals, for example, one may not know which mine they all come from (or even which country). The consequence of this is that many investigations, then, may identify only potential upstream sources based on trends, production totals, import/export statistics, and other general indicators. Assumptions might also be used to help narrow down that generality (for example, an account might note something like: "this country is the source of 90% of this material used in the electronics sector" or "this mine is the supplier of 60% of this mineral in this given country, which we know our target sources from according to their recent sustainability report").

Supplier/Client Investigations - These investigations start in the "middle"—focusing on cataloguing the suppliers (and possibly sub-suppliers) or clients and partners of a particular company (for example, the Apple Suppliers Manifest - https://manifest.supplystudies.com/manifest/samples/apple2013-2019/). This can be a good starting point because it has become more common for companies to include their suppliers in labor and environmental reports, and an investigation based on these reports can begin with detailed information on the various geographies, countries, cultures, etc. enrolled in that companies operations. It can also be problematic. Most supplier reports are partial, and they are rarely broken down by particular products (for companies with more limited or specialized offerings, this could still provide what amounts to an analogue for the supply chain of a particular product, but this is unlikely to be the case for companies with a large and diverse range). When successful, these sometimes develop into more comprehensive upstream/downstream investigations.

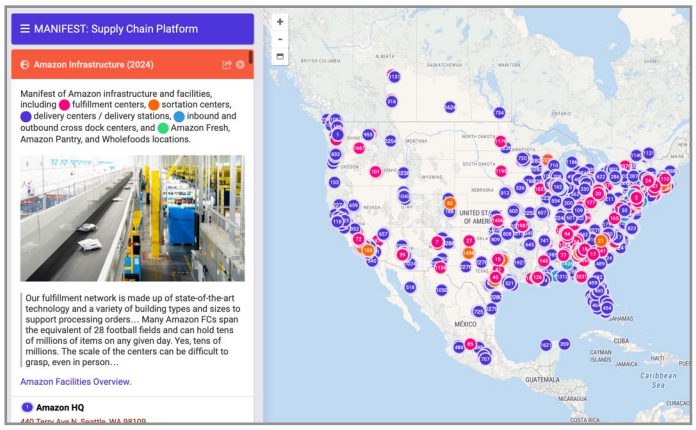


Manifest of Apple Suppliers, 2013-2019.

Hybrid/Synthetic Investigations - Sometimes there can be strategic value in building an investigation that incorporates multiple supply chains. For example, it might be difficult to research, with any certainty, the supply chain for something like a particular model of disposable camera. This is because this is a relatively low-cost electronic product, probably

made with commodity components, and which might be one of dozens of similar models that have a fairly limited lifespan on the market. So while a hybrid or synthetic approach to this investigation might still *aspire* to document that particular model, it might also include research on other models from the same company (with a note that reads something like: " this firm is a supplier of a similar component for another model...") or it might look at other companies altogether ("this company is a large supplier of this commodity component for this sector). Depending on the context, these could help "fill out" the investigation in areas where little direct information could be expected. Often, hybrid manifests will also make assumptions ("while the exact camera sensor supplier for this device is uncertain, this firm provides 70% of the sensors used in the industry, and is a known supplier for similar products by competitors").

Category/Sector Investigations - These investigations expand on some of the approaches used in Hybrid/Synthetic Investigations. They tend to look not at individual products, but entire product categories or sectors. These might be accounts of the "disposable camera" or "hard disk" industry, for example, rather than a model (or two) (see, for example, the Hard Disk Drive Supply Chain Manifest - https://manifest.supplystudies.com/manifest/samples/hdd/). They are distinguished from Component/Constitution Investigations by not limiting themselves to the *raw* materials of a product or product category. Instead, they might detail major suppliers of various subcomponents or parts for a product category or (for a sector like electronics) accounts of key groups like the major chip providers, major battery manufacturers, primary factory zones (or geographic regions) and so on.



Manifest of Amazon Infrastructure.

Facilities/Infrastructure Investigations - While many types of investigations focus on documenting the relationship between sites up and down the chain, we can also think about documenting a particular "slice" of a network. One example of this approach would be to document an industry's relevant logistics infrastructure. This might include things like warehouses, factories, and similar sorts of facilities. Some example of this are the Manifest of Amazon Infrastructure (https://manifest.supplystudies.com/manifest/samples/amazon-infrastructure/) or the Vinyl Pressing Plant Manifest.

Commodity/Production Distribution Investigations - Another kind of network "slice" could be focused on documenting

> The final—and ongoing—step in any investigation is to carefully document the sources for a given account (including where any images or measures come from) and the assumptions you've made in the research process. *All* supply studies have assumptions, and we should always be transparent about what these assumptions are. Perhaps you know that a particular company provides 90% of a certain material worldwide, and you know it is a supplier for your target, and you know that your target uses that material. But you don't know for sure that they supply it in this specific case. It might reasonable to assume they do in your investigation—but you should be transparent about this assumption and explain why you think it is a reasonable inference to make.

sources for commodities or the movements of commodities (such as the Uranium Distribution Manifest - https://manifest.supplystudies.com/manifest/samples/uranium/). A related type of investigation might focus on things which—while not necessarily something we might think of as a commodity—have a similarly well-defined (often constrained) production landscape (such as the Manifest of Algae Biofuel Producers - https://manifest.supplystudies.com/manifest/samples/algae/).

Supply Studies Research Methods

This section presents some of the methods used for studying supply chains and logistics. While far from exhaustive, these are some of the methods most commonly employed by researchers in the critical study of logistics:

Following the Thing
In this method, a researcher follows an object on a journey. This might mean following the extraction of a raw material to its incorporation into a finished product. Or it might mean following something from point of sale to the trash pile. While the object can be anything, journalists often select something familiar to the general public. Scholars might follow objects with specific historic importance, or for which the journeys provide particular insights into specific harms (environmental, social, or otherwise). As Stephanie Sodero, Amy Barron, and Laura Pottinger, describe it:

Illustration from “Follow the Thing Research Guide” (https://aspect.ac.uk/resources/research-methods-follow-the-thing/). Image created by Stephanie Sodero and Jack Brougham.

> Follow the Thing is a social science method that traces the journey of a given product, from donated blood to fair trade coffee. It involves thinking with, and through, a specific good and its supply chain. The method surfaces often-overlooked processes, dynamics, and connections between people, services, and infrastructures. In doing so, Follow the Thing is used to understand interconnections and to explore and expose complexities, vulnerabilities, and injustices.[2]

Some examples of work in this area might include:

> **How Stuff is Made** (Natalie Jerimijenko and others, 2005-2010): A web-based project initiated by artist Natalie Jerimijenko, “How Stuff Is Made” collected and documented the production processes underlying a variety of consumer products.

The Planet Money T-Shirt Project (2013): A podcast series that tried to follow the production process of a t-shirt.

The Mushroom at the End of the World (Anna Lowenhaupt Tsing, 2015): A book documenting the supply chain of matsutake mushrooms, a rare delicacy, from the forests of the Pacific Northwest United States to the markets of Japan.

Follow the Thing: Papaya (Ian Cook, 2004): A project outlining a multi-locale ethnographic research into the globalization of food, focusing on a supply chain stretching from UK supermarket shelves to a Jamaican farm, and concluding in a North London flat.

There's No Such Thing As a Free Watch (Jenny Odell, 2017): A study of the drop-shipping business model traced through the provenance of a wristwatch.

Ethnographies of Logistical Labor

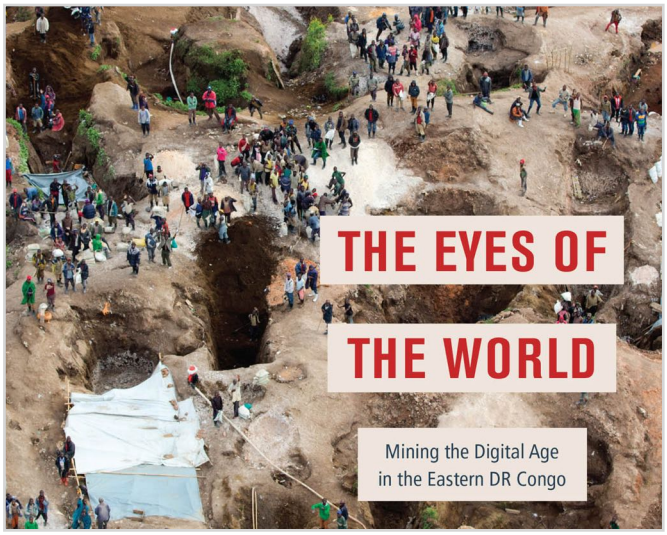
Logistics is not just an abstract system for organizing the output of labor. At a fundamental level the supply chain is constituted by the labor of workers—in factories, on ships, at ports, in long-haul trucks, and so on down the chain. This approach is centered on the accounts of these actors. It may surface these accounts to highlight labor related to a specific commodity (such workers in a factory making a particular product) or it might emphasize the diverse contributions that a specific kind of labor has across global logistics itself (such as in accounts of miners and dockworkers).

Some examples of work in this area might include:

Fish Story (Allan Sekula, 1995): A photographic exhibition resulting from seven years of documenting harbors and port cities around the world.

The Truth Behind the Click (BBC Panorama, 2014): A documentary about working conditions in UK Amazon fulfillment centers.

Yiwu: The Chinese City Where Christmas is Made and Sold (Tim Maughan, 2014): A journalistic account of the international trade market in Yiwu, China.



Cover Image for James H. Smith's *The Eyes of the World: Mining the Digital Age in the Eastern DR Congo*.

Supply Chains and Unfree Labor: Regulatory Failure in the Case of Samsung Electronics in Slovakia (Rutvica Andrijasevic and Tonia Novitz, 2020): An article examining the harmful conditions that migrant workers face when employed under temporary work agreements in Slovakia.

The Eyes of the World: Mining the Digital Age in the Eastern DR Congo (James H. Smith, 2021): A deep ethnography of miners in The Democratic Republic of the Congo—a

> key source of minerals used in the global economy, including tantalum, a mineral used in capacitors used in digital electronics— that explores their understanding of their own role in the digital electronics supply chain.

Logistical Software Studies
This form of inquiry focuses on the tools used by companies and governments to manage their supply chains. Here, the gap between managerial perception and lived experience of workers is a key area of interest, as is the interplay between the abstractions of systems and the materials, processes, and people they model.

Some examples of work in this area might include:

> **The Software that Shapes Worker's Lives** (Miriam Posner, 2019): An article documenting the training program provided by SAP for their supply chain management software.

Logistical Imaginations
The study of logistical imaginations looks to understand the "new ways of seeing and listening, reading and knowing, thinking and moving" that logistical technologies produce. It also considers how representations and symbols—like the cargo container or the Amazon delivery truck—help to constitute the reception of supply chain capitalism within society.

Related Fields and Methods

Supply chains touch almost every aspect of human existence, and nearly everyone on the planet has some stake in the operations of logistical systems. It follows then, that the critical study of logistics has drawn practitioners from a wide variety of disciplines—anthropology, geography, journalism, media studies, history, science and technology studies, labor studies, and economics. In this section we detail a small sample of notable allied areas of research employed in supply studies or which offer methodologies that could provide useful points of reference for supply chain investigations:

Global Political Economy: The study of political economy is a discipline that emerged in the 18th century to examine the relationship between the state and economic forces, particularly with regard to the mechanisms for the production and distribution of goods. Global political economy highlights the impact globalization has had on these mechanisms, and the complex changes that have taken places over the the last several decades.[3] While the state continues to be a critical economic actor, we must now contend that it is one which "must share the stage with a wide range of nongovernmental and governmental actors at the subnational and transnational levels."[4]

Political Ecology: Political ecology is a research field within anthropology, geography, and related disciplines that "has become well known for its analyses of how and why structural forces, such as capitalist economic processes and power relations, drive environmental change in an increasingly interconnected world."[5] Given the environmental stakes of logistical processes, and measurable harms propagated by global supply chains, political ecology

offers powerful tools and theorization for supply chain researchers interested in exploring these impacts.

Some examples of work in this area might include:

> **Political ecology of global supply and commodity chains** (https://www.wigeo.uni-bayreuth.de/en/research/pol_oekologie/index.html): A research initiative that argues that "recent sociological diagnoses of the world ecology of capitalism and practices of externalization all problematize the access of the Global North to the social and ecological resources of the Global South as well as the spatial and organizational outsourcing of negative effects to other societies." This project "take[s[this diagnosis as the starting point and show[s] that such externalization processes are not only based on systemic and habitual prerequisites, but also on infrastructures of modern logistics," arguing that "it is precisely these 'dark sides' of global logistic operations that are neglected in the literature on transport geography, global goods chains, value chains and production networks."
>
> **Dimensions of Political Ecology** (https://www.politicalecology.org/): A group hosted by the Political Ecology Working Group, an interdisciplinary group of graduate students at the University of Kentucky. Since its inception, this student-organized conference has become one of the largest forums for critical discussions at the intersection of ecology, political economy, and science studies, offering a platform for established and emerging scholars.

Life Cycle Analysis: Life cycle analysis (LCA) "quantifies the environmental impacts associated with a given product." In LCA, researchers create an inventory of the resources used and pollutants generated in product production and use. From this, an impact assessment estimates the product's effects on human health, ecosystem function, and natural resource depletion.[6] Because of the complex entanglements of contemporary supply chains, life cycle analysis is a useful tool for understanding the impact of a product, but on which requires a sufficient understanding the supply chain so as to be able to assess the full scope of its externalities.

Network Analysis: Supply chains are *not* chains, but complex and interwoven networks. Network analysis provides techniques for analyzing and studying mathematical graphs. In supply chains, this might involve understanding connections between companies, factories, transit corridors, or any of the thousands of actors involved in production or distribution.

Infrastructure Studies: Infrastructure studies, or *critical* infrastructure studies, is a multidisciplinary field that considers "how looking at the world through the concept of infrastructure—of things and systems made, built, shaped, crafted, interwoven, old, new, lived, loved, hated, sustained, or resisted—can make a difference."[7] Infrastructure—from railroads and roadways to ports and warehouses—is fundamental to the operation of global logistics, and infrastructure studies frequently intersects with the critical study of logistics.

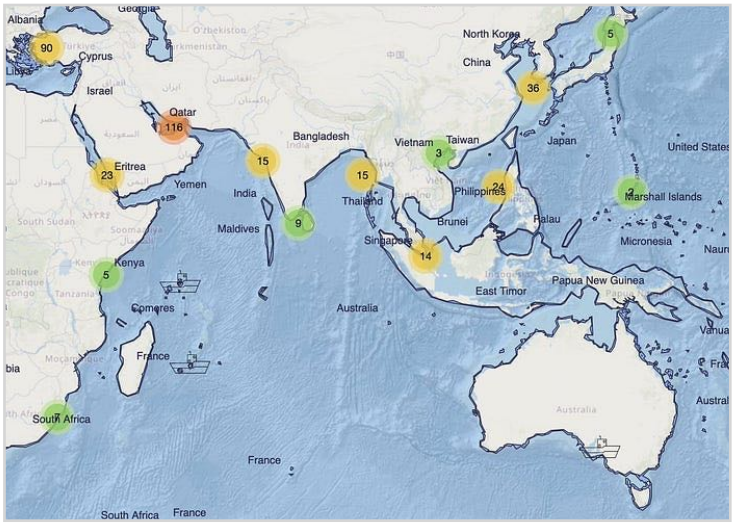
Some examples of work in this area might include:

> **Manufactured Landscapes** (https://www.edwardburtynsky.com/projects/films/manufactured-landscapes): A documentary on work of Edward Burtynsky, who makes

large-scale photographs of “manufactured landscapes”–quarries, recycling yards, factories, mines, dams. In photographing civilization's materials and debris in a way often described as “stunning” or “beautiful,” he raises questions about ethics and aesthetics that have no simple answers.

The Maintainers (https://themaintainers.org/): A global research network that is “focused on advancing maintenance, repair, and care,” gathering interdisciplinary change-makers, researchers, practitioners, and every-day people “who center maintenance, repair, and care and the myriad forms of labor, expertise, and infrastructure that sustain our human built world.”

Ocean Studies: While not all of the supply chain moves on container ships, or transits through ports, canals, and waterways, these pathways are a critical form of distribution in global logistics. The ocean is a critical object in other ways, rising sea levels have made it one of the most visible signs of climate change, and it is a locus of concerns over all manner of environmental pollution, from microplastics to oil spills and industrial waste. As a result, scholars from a number of disciplines, including geography, anthropology, history, and environmental studies have looked to the ocean.[8]



Screenshot from Map of Seafarer Abandonment (Eliza Ader, Jacob Bolton, & Miriam Matthiessen, 2023; https://abandonedseafarermap.cargo.site/).

Some examples of work in this area might include:

Map of Seafarer Abandonment (Eliza Ader, Jacob Bolton, & Miriam Matthiessen, 2023; https://abandonedseafarermap.cargo.site/): A web map that considers how “every year across the world, hundreds of seafarers are abandoned.” Left stranded in ports around the world by their employers—without pay, often lacking food, water, electricity, or the means to go ashore or return home, this map shows all abandonments in the International Labour Organization’s database.

Speculative Design: Speculative design is a methodology embraced by artists, designers, architects, and urban planners that explores future possibilities and societal impacts of emerging technology alongside their shifting cultural and social trends. Its goal is to provoke thought, debate, and directions for how these tools might be integrated into society. Given the potential of technologies like artificial intelligence, robotics, drones, and automated mobility for the supply chain, speculative design offers a mechanism for imagining potential and alternate futures.

Technologies of Globalization: Science and technology studies is an interdisciplinary field that examines the development and impact of science and technology in a historical, cultural, and social context. The history of technology is a related field that looks at these relationships from a primarily historical perspective. Scholars in both areas have increasingly looked to how technology has shaped contemporary globalization. From the perspective of supply studies, they examine how a myriad of technologies (like the automobile, cargo container, telephone, and computer) have become central to understanding the development of global logistical operations.

Empire and Colonial Studies: In the landscapes that logistics operates on, it builds on histories of colonialism and empire that constituted the global power dynamics and social inequities that exist today. This history of colonialism "structures relationships between peoples in a multitude of ways. It gives rise to distinct bodies of literature and art, as well as political subjectivities and brutal economic inequalities." The study of colonialism and empire, then, crosses a ranges of fields—looking to understand the legacy of these processes, particularly within the Global South.

The Digital Humanities

Digital Humanities broadly refers to the use of digital technologies in the service of humanities and the social sciences, usually as a complementary method alongside more traditional qualitative approaches. The critical study of logistics lends itself well to a digital humanities approach, in part because so much of logistics involves quantification and data: distances traveled, volumes of goods shipped and sold, labor spatially situated. Incorporating data analysis and visualization into critical logistics work is another way of communicating the scale and complexity of a supply chain. We describe our Manifest project (see chapter 6) as a digital humanities tool for the critical study of logistics, though it incorporates other supply chain methodologies and those of allied fields.

There are few other projects that explicitly adopt this framing, and there are a number of projects that might be considered within this methodology—in other words as digital supply studies projects in the service of the humanities and social sciences: Some examples might include:

> **Port Botany Visualization:** Developed as part of the Transit-Labour research network, a collaborative project investigating changing patterns of labor and mobility in Asia, the Port Botany Visualization software application is a representation of "wharf activity and truck turnover times at Port Botany, Australia."

Notes

[1] Mario Rautner, "Supply Chain and Product Investigations," *Exposing the Invisible: The Kit*, https://kit.exposingtheinvisible.org/en/supply-chain.html.

[2] Stephanie Sodero, Amy Barron, and Laura Pottinger, “Follow the Thing,” in *Methods for Change* (Aspect and The University of Manchester, 2021), https://aspect.ac.uk/wp-content/uploads/2021/03/Stephanie-Sodero-A4-Guide.pdf.

[3] James Caporaso and David Levine, *Theories of Political Economy* (Cambridge University Press, 1992).

[4] Theodore Cohn, *Global Political Economy: Theory and Practice* 8th edition (Routledge, 2020).

[5] Jason Roberts, “Political ecology,” in *The Open Encyclopedia of Anthropology* (2020).

[6] Jason Hill, “Life Cycle Analysis of Biofuels,” in *Encyclopedia of Biodiversity* 3rd edition (Elsevier, 2024).

[7] Critical Infrastructures Studies (2022), https://cistudies.org/about/.

[8] Oceanic Humanities for the Global South (https://www.oceanichumanities.com/) and John R. Gillis, “The Blue Humanities,” *Humanities* 34.3 (May/June 2013)

III. Sample Investigations

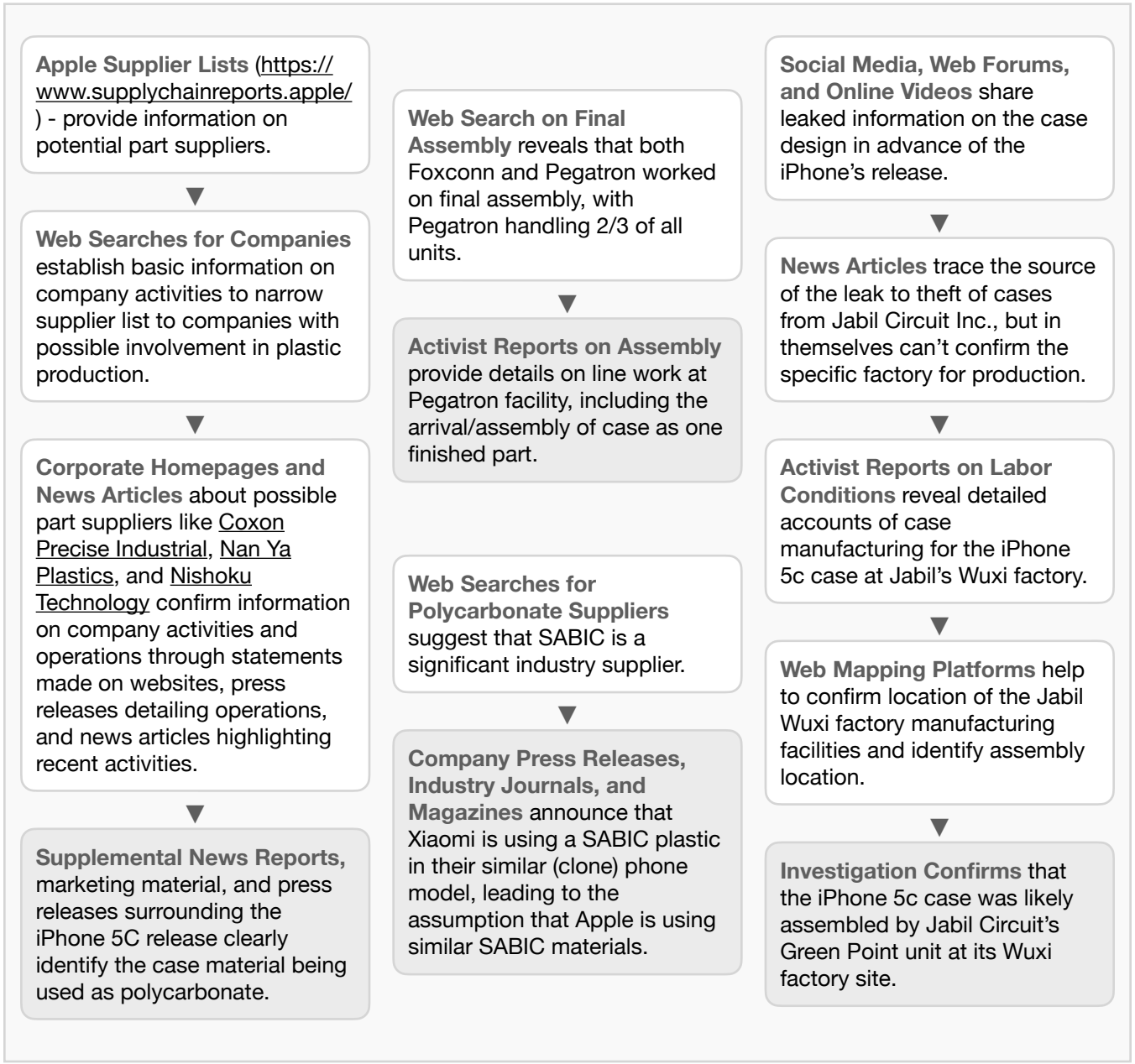
A Sample Investigation: iPhone 5C Case

This section of the research guide presents a sample supply studies investigation, walking through the research process not for an entire product, but for just a single part—the plastic case manufactured for iPhone 5c.

The iPhone 5c was released in September of 2013 alongside its upmarket counterpart, the iPhone 5s. A great deal of speculation surrounded the introduction of this new “low-cost” iPhone, and so did a great many questions. Chief among these was what, exactly, the “C” stood for. The “S” that had appeared alongside the name of every mid-cycle revision since the 3GS had, after all, a similarly murky meaning. The first release stood for “speed.” For the next, commentators suggested that it might signify the Siri voice assistant. An entirely new letter lent itself to even more ambiguity. Perhaps, some suggested, it stood for “color.” Unlike prior models, the 5c came in colors beyond the familiar black, white, and metal. These new hues included blue, green, yellow, white, and a pink that the company called “coral.” But the only indication of this difference (other than the obvious) was an internal barcode (hidden inside the iPhone’s shell) and an electronic encoding in the device’s boot ROM—the phone’s model number differentiated only by compatible carrier.[1] Some argued that it described the market —”consumer,” perhaps, or “cost.” Others suggested a less flattering option. But while this phone was less expensive than many of Apple’s other products, one would be hard-pressed to describe it as “cheap.”

iPhone 5c cases, numbered with qr codes and with hand written batch numbers on the interior.

Apple's chief designer, Jony Ive, said only that the 5c was a "distillation" of what people loved about the iPhone 5, just one that was "beautifully, unapologetically, plastic." Hewn from "a single piece of polycarbonate" and fixed to a steel reinforced frame, the materials of the case constituted, he explained, a kind of "bespoke assembly."[2] This was reflected in the fact that—unusual for a phone with a plastic case—the holes for the buttons and rear plate were machined rather than molded. Undergoing multiple finishing processes, with a clear lacquer hard coat providing a final polish, the result was tough—three times stronger than the PET film used to scratchproof the display. But it was also lightweight. Just a little under 60 mm wide, 124.55 mm tall, and 8.98 mm deep, the case weighed 14.2 grams—a tenth of the phone's total. Even with its ultimately disappointing sales (reported to be only 24 million), this amounted to 340 metric tons of plastic resin over the life of the product.[3] Our question then, is where this case came from: who made it—and where.



Despite the attention the case received in Apple's marketing, public discourse on their supply chain tended to focus on internal components like batteries and microchips—as if the object's most visible part was somehow too obvious to study. As a company, Apple is notoriously reticent in describing the base details of its product's manufacture. But the supply chain of the iPhone is not—at least not entirely—a secret. After all, Apple has (since 2011) published a yearly accounting of the suppliers of its products (https://www.supplychainreports.apple/). For our investigation, this list represents a good starting point for potential plastic suppliers. But this list is neither complete (it represents only the "top" percentage of suppliers), nor differentiated, nor does it offer an explanation as to the role of the companies it contains. One company may play many parts, and rarely is there any clarity as to individual responsibility for a component. For example, initial web searches confirm that the list includes a number of *possible* plastics suppliers (companies like **Coxon Precise Industrial**, **Nan Ya Plastics**, and **Nishoku Technology**). But what any of these firms provide specifically, let alone what part they provide for a specific product, requires more research. The corporate homepage (and several new articles) suggest that Nan Ya Plastics specializes in synthetic rubber. But they are also a supplier of a "protective shell material polycarbonate," in whole or in part. **Nishoku**, to look at another option, has been linked in news reports to "casing" production at its factory in Kunshan. Could this be our supplier?

The reality is that looking for one single supplier may not even make sense. It is reasonable (even likely) to assume that these components are shared across a number of product lines. After all the "supply chain" hardly resembles the ordered linking its name implies, and it would be almost unthinkable for Apple to depend on a single supplier for any part (though there are chokepoints). At the deepest depths of the chain, questions of provenance become matters of probability. Even in the immediate upstream, it would be difficult to definitively identify the company responsible for delivering a component like our case.

Nishoku's Kunshan Facilities (https://www.nishoku.com.tw/en-US/Home/About).

Given its high-profile appearance in the company's product matrix, an analysis of the 5c offers a unique opportunity to narrow down the particulars of Apple's sprawling supply chain. While the company continues to experiment with "low-cost" iPhones, at the time of release the plastic shell of the iPhone 5c set it apart—and this sort of differentiation is always useful for supply chain investigations. Apple has used, and indeed continues to use, polycarbonate—notably in products like AirPods. But in 2013, news of an entirely plastic iPhone was novel enough to bring widespread industry attention. It reflected Apple's response to rising competition in the high-end mobile market. Plastics like ABS and polycarbonate allowed manufacturers to cut expenses without sacrificing "design flexibility" by enabling lightweight, visually attractive

products that were cheaper to manufacture.[4] As a result, Apple's "unapologetic" move into plastics offers an opening. But even without this opening, we know where the case will end up.

Pegatron

We might start, for example, with final assembly—the place where the case is put onto a finished iPhone before it is shipped to consumers. Popular imagination would suggest this would be done by **Foxconn** at its Zhengzhou manufacturing plant. But a quick search reveals that it was actually **Pegatron** (Heshuo United Technology Co., Ltd.) that was tasked with filling two-thirds of the iPhone 5c's orders. This means that it is reasonable to assume that this is the company most likely responsible for the assembly of the case in any given phone. Activist investigations can be valuable sources, and China Labor Watch confirms the case being assembled on the line:

> The task on my assembly line is to assemble back covers. The assembling of other parts of the cell phone, including the final assembly into a finished product, is assigned to different production facilities, each facility partitioned off by heavy curtains so that workers in different departments are isolated from one other. Today's work is to paste protective film on the iPhone's plastic back cover to prevent it from being scratched on assembly lines. This iPhone model with a plastic cover will soon be released on the market by Apple. The task is pretty easy, and I was able to work independently after a five-minute instruction from a veteran employee. It took around a minute to paste protective film on one rear cover. The new cell phone has not yet been put into mass production, so quantity is not as important. This makes our job more slow paced than in departments that have begun mass production schedules.[5]

This Labor Watch report confirms one end of the chain, the suggestion that it is at **Pegatron**—and in the hands one of the 100,000 workers employed at its Shanghai campus at the end of 2013—where our case will end up. It also makes it clear that the case was not built here as some more complex subassembly. It arrived to the manufacturing plant as a separate, complete part.

SABIC

Polycarbonate is a thermoplastic polymer that is both strong and easily worked. We believe it is the primary component for the case because Jony Ive said so. Even without this confirmation, it would be a good guess. At the time of the 5c's manufacture polycarbonate had been popular in a wide range of manufacture over the past several decades, with particular resins marketed under a wide variety of brand names. These include Makrolon, Tecanat, Acetron, Luran, Retain, Lustran, and, of course, Lexan.

SABIC is the world's fourth-largest chemical producer. Given the extensive nature of its portfolio, what, exactly, the Saudi Arabian Basic Industries Corporation might do for a company like Apple is something of an open question. But web searches reveal that in 2013 it was Apple's use of **SABIC** Innovation Plastics as a polymer supplier that received industry attention. **SABIC's** large supply of polycarbonate resin, and the color capabilities they were noted for, would have been a fit regardless of whether the "c" stood for cost or color. Indeed,

web forums and news articles included reports that Apple required **SABIC** to carefully customize colors to the firm's exacting specifications, developing unique color numbers not just for the 5c's novel "coral," but even for its seemingly nondescript "white."

Pegatron's Shanghai campus (http://www.bloomberg.com/news/features/2016-04-24/inside-one-of-the-world-s-most-secretive-iphone-factories).

As far as our investigation goes, we know that **SABIC** had three potential subsuppliers in 2013: in the United States, in Shanghai, and in Guangzhou. But what resin, which supplier, and what location is not something we can get from SABIC or Apple. But we can find a clue from their frequent imitator, Xiaomi. After all, hile Apple is adverse to sharing details on its productions and partners, Xiaomi is not. And there were numerous articles, interviews, and press releases on its plastic phone.

As **SABIC** describes it in an industry article, the Lexan EXL1414 Xiaomi used for the back case "is a medium flow opaque injection-molding grade material."[6] With rich color options, impact resistance, and low temperature ductility, it enables shorter injection molding cycles when compared to standard polycarbonate resins. While we can't say for certain that this is the exact material designation and supplier site for Apple's case, it would make sense for them to have made a similar choice.

This gives us two pieces of the supply chain, a likelier than not final assembly at **Pegatron's** Zhengzhou plant and raw materials supplied by **SABIC** (and, given the proximity to final assembly, probably from its Shanghai supplier). But what about the steps in-between? The China Labor Watch report indicates that the cases assembled by Pegatron come with metal and polycarbonate already attached. So who attached them? Who worked the raw materials into the form of a finished case, and where? In most circumstances, we might have to stop here—to comb through the list of Apple's suppliers and—if no searches come up with any specific connections, and if we have no informants who worked on the product—note down only the *possible* manufacturers. But in this particular case we have some additional clues.

Raw Materials provided by **SABIC** (Lexan EXL1414) from its Shanghai supplier.

Manufacture by **Jabil Circuit** at their Green Point unit's Wuxi factory.

Final Assembly by **Pegatron** at its Shanghai manufacturing facilities.

Jabil Circuit

After all, while the iPhone 5c may have been officially unveiled at Apple's September "special event," this wasn't the first time enthusiasts had seen it. Though largely unreported at the time, a warehouse employee had made off with some copies of the case, and this was the source of the unauthorized videos that were appearing all over web forums and social media. Suppliers like **Catcher**, **Zeniya**, **Amphenol**, **Murata**, **Laird**, **Lateral**, **Lite-On**, **Molex**, and **Pioneer** all had molding capabilities that could have been used for the 5c, as did Foxconn itself. But there was only one who was responsible for this secondary trace.

Jabil Circuit Inc. is an American manufacturing service company headquartered in St. Petersburg, Florida. Founded in 1966, it employed over 180,000 workers in 90 factories at the time of the 5c's manufacture—one of whom was responsible for the leak of the 5c's plastic case.[7] But even if we never had confirmation that **Jabil** was the source of this leak, there would have been plenty of reasons to suspect their involvement. With machinery allowing them to mass produce high-end plastic and metal moldings for OEMs like Nokia, Motorola, and Blackberry, they were not only one of the world's largest contract manufacturers of electronics, but a world-scale injection molding company—with over 755 injection machines operated by their Green Point unit in 2010.[8] And if leaked cases and industry speculation were not evidence enough, a second China Labor Watch investigation later confirmed that it was **Jabil's** factory in Wuxi that was responsible for producing "the rear plastic covers of Apple's so-called cheap iPhone."[9]

Jabil Green Point's Wuxi facility. Jabil's website (https://www.jabil.com/contact/locations/wuxi.html) describes it as "the first Jabil Lean Mode factory" with "1,6000,000 [sic] sq. ft." of manufacturing space.

At the time of the investigation, **Jabil** managed eight factory buildings and more than 30,000 workers at their Green Point Wuxi facility. The China Labor Watch report alleged a number of abuses at Green Point, observing that more than 80% of workers interviewed reported hours

exceeding Apple's 60/week standard, with some as high as 100. Salaries could be as low as 1,500 Chinese yuan (~$245) per month (including unpaid overtime). The report admonished that "Apple products are manufactured at the expense of Chinese workers, laboring in factories owned by Taiwanese, Hong Kong, and, in the case of **Jabil**, US-owned companies." **Jabil** disputed the allegations, arguing their focus on "continuous auditing – by internal, independent third-parties and customers" was generally able to identify issues and improve compliance. But they conceded that they were not always perfect. "We are disheartened that there are allegations that we are not living up to our own standards."[10]

For our purposes the critical part of this investigation is that it confirmed that it was the Wuxi factory which had—for several years—been responsible for making the "finely polished" "molding" on the back of iPhones, as well as the "metal band" and "metal shelf" used to secure their internal components. It was here, in **Jabil's** Wuxi factory, where plastic and metal were fashioned and fused, where the steel reinforced frame was affixed to the polycarbonate case that would comprise the iPhone 5c's "bespoke assembly."[11]

As this short sample investigation suggests, performing the supply study of even a part can be a difficult, nonlinear endeavor. And even this partial story is uncertain, colored by probabilities. After all, not every case was assembled at **Pegatron**. We aren't entirely certain that it was **SABIC** supplying the raw materials. And even if we take the China Labor Watch investigation—with its seemingly definitive proof that the case was manufactured at the Wuxi factory—completely at face value, this doesn't meant that there weren't other nearly identical cases made by other, less obvious, manufacturers. But while this investigation comes with caveats and cautions, it also reveals the enormous possibility of this kind of investigation. Here we learn about dozens of possible companies that contribute to smart phone manufacture in this and other devices. We get different perspectives on the lives and labor wrapped up in the supply chain, the design perspective of Apple giving way to industry and supplier responses, and direct observations of workers on the line. Like all supply studies investigations, it demonstrates that it *is* possible to open up the supply chain—even if we must also acknowledge that its deepest depths may always stretch just beyond our reach.

Other Sample Investigations

Of course, this is just one example of what a supply studies investigation might look like. There are plenty of others that you might look to for inspiration. While we will see some other case studies in chapter 5, this section describes some additional sample investigations:

Investigating a Bauxite Mine (Exposing the Invisible)
This sample investigation looks for the presence of mineral in consumer products from a (fictional) South American bauxite mine run by a known company. Starting with the company name, registration information, and list of key personnel, the investigation begins by looking for a wide variety of information from a number of different data sources:

> physical company operations and locations from maps and satellite images; the structure of the company from company registries; financial information from company filings, annual reports, and stock exchanges; addresses from online and offline corporate records and the company's website; board members and directors from company registries, the company

> website, and databases; bank connections, loans, and mortgages from corporate records, court records, and annual financial reports; employee feedback, reviews, and grievances on sites like glassdoor.com, comparably.com, careerbliss.com, and career or job opportunities from the company's website and archives of job postings from archive.org (this can suggest information about future projects, locations, and plans).

Starting from this information, the investigation constructs a supply chain model:

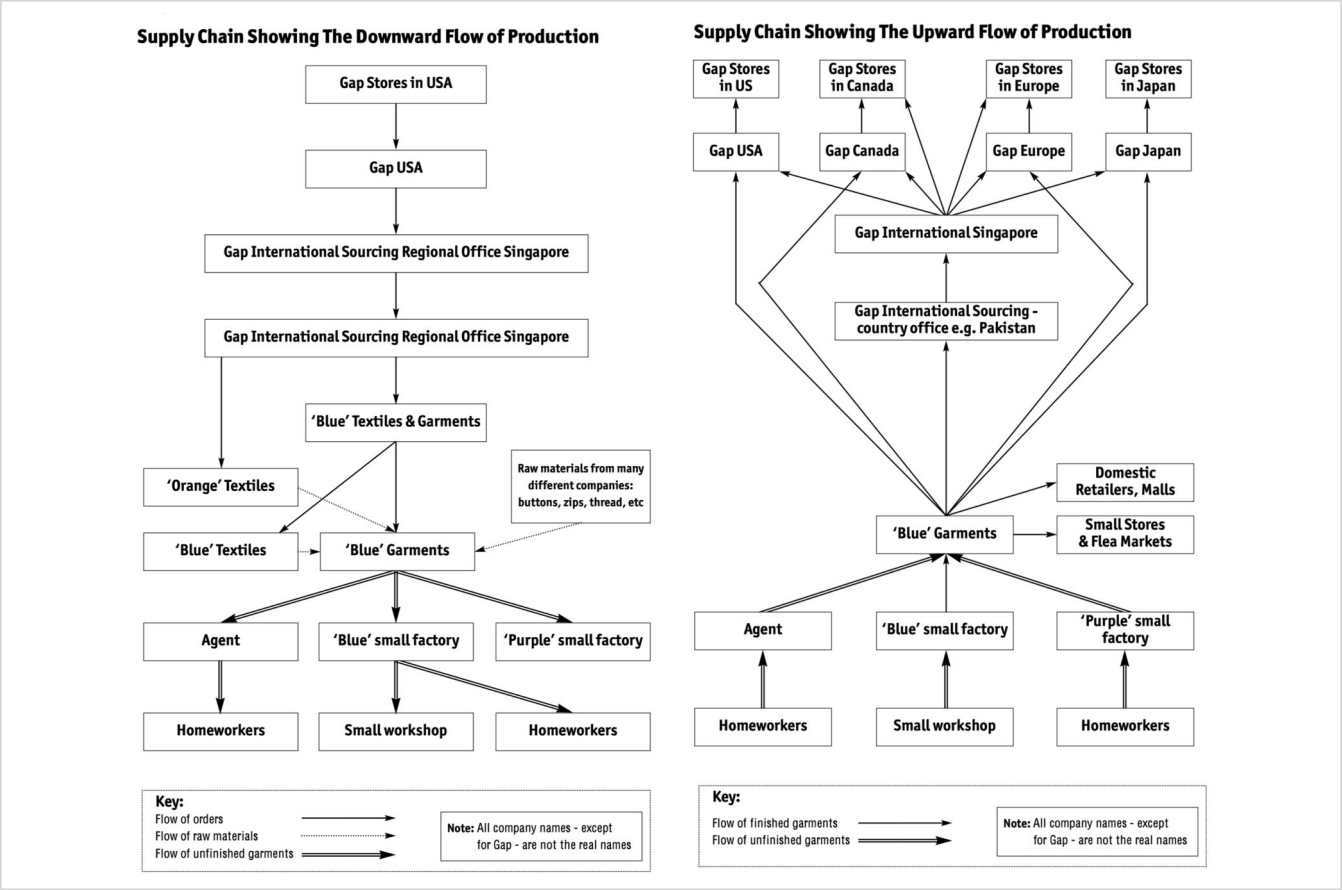
Mine ▸ Metal Smelter ▸ Shipper ▸ Importer / Processor ▸ Manufacturer ▸ Brands ▸ Retail

It identifies an aluminum smelter (because this is one of the common uses of bauxite) and observes that this is a relatively narrow global pool (less than 150 viable companies worldwide). Given this, the investigation looks for the presence of smelters in the target country as well as other bauxite mines, cross-referencing this information with the UN Trade database Comtrade. Looking at transportation options in tools like Google Maps and Google Earth, the investigation locates a shipping subsidiary and rail connections connected to a local port. Using AIS data (used by vessel tracking services) from sites such as marinetraffic.com and vesseltracker.com, the investigation watches vessels at this port from the shipping subsidiary and traces them to a potential smelter.[12] Using customs data obtained from services like tradeatlas.com, importgenius.com, xportmine.com, importyeti.com, and panjiva.com, the investigation looks at HS Codes (the classification system for importing goods) and identifies a manufacturing company importing aluminum sheets from the smelter.[13] The website for this manufacturing company shows pictures of popular soft drink company labels. The sample investigation uses this to follow production to retail grocery stores, with the caution that additional investigation, interviews, and site visits may be needed to confirm and validate this information.

Computer Chips (Emerging Technology Observatory)
The Supply Chain Explorer is an interactive, high-level visualization of the supply chain for advanced computer chips, designed to quickly orient non-experts to the essential inputs, players, and relationships involved in producing this critical resource.

Investigating Container Shipping (Charmaine Chua)
This ethnographic account by Charmaine Chua (https://thedisorderofthings.com/tag/slow-boat-to-china/) follows her trip on a 46-day journey on board a 100,000 ton Evergreen container ship starting in Los Angeles crossing the Pacific Ocean for Taipei.

Gap: Example of a Global Chain (Garment Supply Chain Education Pack)
As part of its facilitation materials, the Garment Supply Chain Education Pack examines the Gap supply chain and with a flow diagram “show[s] the many different people, companies, agents, offices, factories and other workplaces involved in the Gap supply chain.” From here it asks two simple questions: “Who are they, and what do they do?”



Gap Supply Chain (Downward and Upward Flows) from The Garment Supply Chain Education Pack.

Other Research Considerations

Security

Depending on the research strategy employed and the geographies of interest to the investigator, supply studies research can come with significant risks. The critical study of supply chains is not neutral, and asking questions can be perceived as a threat to the individuals and corporations who control the supply chain. The form of the investigation can have an impact here as well. There is a significant difference, for example, between a time-sensitive journalistic article and a retrospective academic study. Some investigators may choose to stagger the release of their results in order to properly assess their impact. But all investigators need to be methodical about their methods for collecting and preserving data, notes, and other research documentation. Hard copies should be secured. Digital files should be backed up and encrypted.

Safety

Supply studies research can require field research in addition to online or remote data collection. Risks exist in both cases, but field research can be especially high-risk, especially if it involves access to countries or regions with high levels of corruption or where violence occurs frequently. And this risk can vary widely. There is a big difference, for example, in conducting a labor study with Amazon Flex workers on a platform like reddit and studying

conflict minerals by visiting the communities where extraction occurs. This latter sort of high-risk work "should only be undertaken by experienced investigators," and it should only be undertaken with sufficient preparation and support from local collaborators.[14]

Of course, you are not the only person at risk in an investigation. Informants may provide information about the companies they work for, and you may even ask informants to gather this kind of information. Investigators and other actors enrolled in the supply chain often have different goals. You need to be aware of these differences. Ensure that your informants are aware of the risks they are taking and make every effort to protect them. At the same time, different fields have different approaches to the ethical concerns raised here. Journalists may be advised to consult their professional best practices about interacting with sources (https://cpj.org/2021/11/digital-physical-safety-protecting-confidential-sources/), and ethnographers (especially novice ethnographers) should understand the complex ethical entanglements and personal risks they are undertaking:

> Risks to be taken into account by the ethnographer include not only the protection of self, participant and data, but also being aware of the perception others in the field hold of the position and intent of the researcher (including, for example, whether he or she is a 'spy'), the problem of being partisan or neutral, and the related risk of being targeted by stakeholders in violence or conflicts (including the formal authorities). Ultimately… "managing danger in fieldwork should be viewed as a dialogic ongoing process based on an ethical relationship with research participants, which requires recognizing the shifting nature of danger and risk."[15]

For collaborative projects, investigators should be cautious about communication technologies, employing encrypted messaging platforms (for example: https://signal.org/, https://wire.com/en/, etc.), encrypted email (for example: https://www.openpgp.org/software/), and shared secrets for accessing digital files (for example: http://point-at-infinity.org/ssss/). It is also recommended that investigators store information in systems like git (for example, using https://github.com/ for unencrypted data, or a service like https://keybase.io/ for encrypted data).

Legal

Supply studies investigations often portray powerful companies and powerful people in an unflattering light. They may be directly (or indirectly) implicated in the social and environmental impacts of the supply chains in question. Depending on the nature of the investigation and the nature of the research (activist, journalistic, academic, or legal), publishing the result of such an investigation may require a certain standard of proof. While the abstraction and uncertainty surrounding supply chains makes complete certainty difficult to come by, because "this type of investigation often ultimately exposes very large corporations for whom reputation is as valuable as the products themselves" these companies can "respond strongly when their reputation is under threat."[16] It is not uncommon for supply chain investigations to result in lawsuits (especially SLAPP—Strategic Lawsuit Against Public Participation—suits) for libel and slander, and investigators may be advised to obtain legal advice before publishing the results of their investigation. Even if there is no merit

behind these cases, corporations employ them because they have proven to be effective tools for intimidating investigators and shielding supply chains from critical assessment.

Notes

[1] Everymac, “iPhone Q&A: Differences between iPhone 5c models” (2017), https://everymac.com/systems/apple/iphone/iphone-faq/differences-between-iphone-5c-models.html.

[2] Apple, “Apple iPhone 5C Promo Video” (https://youtu.be/puo-kbtVozM?t=94).

[3] Ewan Spence, "The iPhone 5C Is Not A Failure, But This Myth Holds An Ominous Warning For The iWatch," *Forbes* (June 16, 2014).

[4] "Plastic Established as the New Currency in Cellphone Market, with $4.5 Billion in Revenue by 2017 According to Research from IHS," *Businesswire* (October 3, 2013).

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[9] "Chinese workers exploited by US-owned iPhone supplier," *China Labor Watch* (September 5, 2013), http://chinalab.w17.wh-2.com/upfile/Jabil_Green_Point.final.pdf.

[10] Steve Toloken, "Report: China molding plant for plastic iPhone violates worker rights," Plastics News (September 16, 2013).

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[12] "Top 15 Ship Tracking Websites to Find Your Ship Accurately," Marine Insight (April 1, 2023), https://www.marineinsight.com/know-more/top-8-websites-to-track-your-ship/.

[13] "Harmonized System (HS) Codes," Understanding HS Codes and the Schedule B, International Trace Administration https://www.trade.gov/harmonized-system-hs-codes.

[14] Mario Rautner, "Supply Chain and Product Investigations," *Exposing the Invisible: The Kit*, https://kit.exposingtheinvisible.org/en/supply-chain.html.

[15] Kees Koonings, Dirk Kruijt, and Dennis Rodgers, "Ethnography as 'Risky Business,'" *UVRN* (2019), https://urbanviolence.org/ethnography-as-risky-business/ and Jeffrey Alan Sluka, “Managing Danger in Fieldwork with Perpetrators of Political Violence and State Terror," *Conflict and Society: Advances in Research* 1 (2015): 109–124 (quoted).

[16] Mario Rautner, "Supply Chain and Product Investigations," *Exposing the Invisible: The Kit*, https://kit.exposingtheinvisible.org/en/supply-chain.html.

IV. Techniques and Data Sources

Doing supply chain research requires supply chain data. This might be *quantitative* data, like information about the number of shipments, costs of components, or specifically quantifiable environmental or social impacts like information about industrial water usage, overtime hours, or worker wages. It may also be *qualitative* data, like descriptions of how logistical processes have shaped particular geographies, or accounts of the lived experience of workers in communities impacted by global supply chains. Certain methodologies may be more suited to some types of data than others, and for most investigations a combination of methods is necessary. This section examines particular techniques for gathering data, and the kinds of data sources that are commonly considered when conducting a supply studies investigation.

Techniques

Techniques are basic tools for acquiring data. These are different from the broad methodologies we covered in the previous chapters—and indeed, many of those methodologies will incorporate a variety of techniques into their practice.

Document Analysis
There are a wide variety of documents that can help a researcher understand a particular supply chain, though the kinds of documents that will most benefit a particular investigation will depend on the industries or companies under examination (and in some cases, what information is made publicly available). Examples of relevant documents might include legal filings, trade records, or corporate disclosures like sustainability or supplier reports. Document Analysis is "a systematic procedure for reviewing or evaluating documents—both printed and electronic (computer-based and Internet-transmitted) material." Like other methods in qualitative research, document analysis "requires that data be examined and interpreted in order to elicit meaning, gain understanding, and develop empirical knowledge."[1]

Supply studies investigators often collaborate on projects or work with others doing similar work, and this can be particularly helpful when approaching an unfamiliar area, or where and additional knowledge and expertise is necessary. Collaborators could be other researchers in the investigator's field, in other fields, or within advocacy organizations, universities, and research centers—especially those with connections to local communities of interest. In some cases multiple individuals may collaborate on one aspect of a supply studies investigation, in others each researcher may focus on a particular aspect, component, or geography.

There are some advantages to local collaboration in particular. Local collaborators may have language skills you lack, or they may be able to access governmental resources (like freedom of information laws) only available to citizens of a particular country. They may also have a sense of the risks of certain forms of inquiry that an outside investigator may not be aware of.

When conducting document analysis one must be cautious to understand the purpose of the documents under consideration. Why were they produced in the first place? What biases might exist for the parties that produced them? Because many documents use technical language and domain-specific terminology, it may be necessary to do some initial background investigation to further an understanding of this language. It may also be valuable to compare the documents specific to your investigation with other, typical documents in the same genre—what is standard, what is exceptional? It is also useful to identify what the goals are for the document analysis. For example: What are the data targets that can be identified *before* the analysis? What are the mechanisms for following up on novel information arising from the analysis? During the analysis itself, it will be important to flag or make note of particular *kinds* of data, particular *uses* of language, etc. that can then be coded as the analysis expands across successive documents. It is also important to keep in mind that not all the information you are looking for will be in the documents you have access to, and that different countries have different requirements for things like corporate disclosures (with not all accessible online or in convenient repositories).

Ethnography

Ethnography is a qualitative method for collecting data about people, usually through observations and interviews that allow the researcher to reach conclusions conclusions about societies and individuals function in them. Ethnographers, in other words, "observe life as it happens instead of trying to manipulate it in a lab."[2] Ethnography can be an especially valuable method for getting information from supply chain actors like workers, and researchers conducting ethnographic investigations may devote a significant amount of time and effort to connecting with potential informants and developing relationships with them. This work may involve visiting the sites frequented by these actors, spending time in the places they spend time, talking to the people they talk to, and so on. This ethnographic inquiry may also take place through online communication, where researchers use social media and digital communication technologies to reach out to and connect with potential informants (either to supplement face-to-face encounters or in place of them). While supply chain ethnography frequently involves contact with factory workers or logistics workers at sites like ports and warehouses, it could also involve encounters with retail workers, logistics professionals, and even consumers.

> Because of the personal relationships researchers may develop with informants, ethnography requires ethical consideration and a duty of care. A worker's relationship with a researcher is not the same as the researcher's relationship with the worker, and significant power differences exist in these relationships. At the same time, ethnographers need to understand the agendas of their informants, which may involve labor organization, retaliation against corporate mistreatment, and other goals which may be complimentary, tangential, or oppositional to the researchers own goals. Researchers should be aware of the difference in these agendas, particularly with regard to the relative value of time. Informants *are* experts, and researchers should meet them with clear, specific questions. This may require significant pre-research processes incorporating other techniques like document analysis. At the very least, it requires a thorough understanding of the kind of information an informant is able to provide, and making sure to direct specific lines of inquiry to the most appropriate people.

Archival Research

When the subject of the investigation is a historical supply chain rather than a contemporary one, investigators may turn to archival research. Archives are not libraries—they are not organized in the same way, and researchers should understand the specific demands of archival work. This typically involves accessing an archive—usually a public, government archive, or a private, corporate archive. For supply chain investigations, most corporate collections focus more on managerial decisions than the day-to-day minutiae of, for example, quality control reviews of specific suppliers. Existing corporations are under no obligation to allow external access to their materials—and indeed, they will usually turn down requests. Even when corporate material is donated to public archives, it is important to note that the availability of these collections is usually (thought not always) limited to larger or more historically significant companies. Other governmental archives can also be useful sources of information about corporate behavior, legislative insights, and all manner of public and private documents relevant to supply chain researchers. In some cases, smaller museums, historical societies, and similar organizations may provide valuable—if usually quite specific—sources of materials such as (for example) the papers of a significant local figure or local records involving nearby factories, mines, and warehouses.

Archives are not libraries—they are often kept in the order the materials arrived in, divided into boxes and folders. The best-case scenario for undigitized archives is that they have a basic finding aid which roughly titles the contents of a folder:

Record Unit 7213
Western Union Telegraph Expedition (1865-1867)

Container List - Box 1

Folder 1: Reports of Major S. Abasa, Chief of Asia Division, February 15, 1866, February 16, 1866, March 26, 1866 and April 19, 1866

Folder 2: Henry M. Bannister

Folder 3: Charles S. Bulkley

Folder 4: Report of Charles S. Bulkley, March 1, 1867

Folder 5: Reports of Richard J. Bush, May 4, 1866, May 24, 1866, June 9, 1866, August 2, 1866, May 28, 1867, November 14, 1866, and July 15, 1867

Beyond archives, investigators may be able to find information on eBay, AbeBooks, or similar websites. Published marketing materials, pamphlets, and trade journals, or sometimes internally-produced corporate histories, catalogs, and documentation sometimes ends up on these platforms and can provide additional detail about about a company, site, or significant figure.

Data science

The hardest part of doing data science on supply chains isn't learning how to code or deciding what statistical software to use: it's getting the data in a format that's easy to analyze. But even tools like Microsoft Excel or Google Sheets can be simple (and collaborative) repositories for collecting and collating data that can be exported so that data science algorithms and processes can extract useful patterns from them. "Many of the elements of data science have been developed in related fields such as machine learning and data mining. In fact, the terms data science, machine learning, and data mining are often used interchangeably."[3] Generally speaking, however, "machine learning" focuses on the design and evaluation of algorithms for extracting patterns from data, while "data mining" describes the analysis of structured data. In any case, the goal of data science work is to uncover a pattern within collected data.

For a supply chain investigation, data science approaches may involve, for example, a large scale analysis of customs records to determine the likelihood of particular products containing components or raw materials produced by forced labor.[4] Another example may be a project that uses product delivery data to attempt to reverse engineer the algorithm behind delivery driving software.[5] In both cases, related data sets are assembled and used to draw conclusions about information that may otherwise be impossible to access directly.

Data Sources

Data from Objects

In some cases, objects themselves can be sources of data. Products carry with them both the details of their material composition and the signs of their assembly.

Teardowns and part explosions can reveal the components of a product—what they are made of and how they come together. While there are more rigorous forms of materials analysis (see below) simply opening up the object helps to understand its operation and assembly. While investigators can certainly do this themselves, there are also sites like https://www.ifixit.com/ that, for certain product categories (high-end electronics, etc.), provide detailed "teardowns" (often for repair documentation or enthusiast examination) showing internal components and assembly details. Youtube has also become a repository of video teardowns, part explanations, and repairs guides for a wide range of products. Todd McLellan's *Things Come Apart: A Teardown Manual for Modern Living* offers a more artistic example of this practice.

iFixit teardown of iPhone 15 (https://www.ifixit.com/News/82867/iphone-15-teardown-reveals-software-lockdown).

Markings and inscriptions used to be common features on products, and some products (such as Men's suit jackets and sports coats, for example) may still include tags or labels that are hand written or marked to indicate inspection or other quality control measures. Many plastic products—like children's car seats, for example—include dial-like mold markings to indicate date of manufacture. And even in high-tech products, internal components may have markings in pencil, pen, or marker that indicate information like batch number or assembly location—though deciphering these may be difficult and their presence is dependent on the facility and material.

Barcodes and QR codes on finished goods can be used to identify the manufacturer and (sometimes) basic information about production, while codes on internal components can be used to identify the component manufacturer, specifications, or the date of production. While internal codes can be proprietary and encode information in a variety of wars, most externally facing codes conform to recognizable standards. The most common of these are European Article Numbers / EAN, which are usually 13 digits and used both within and outside of Europe, and the 12-digit Universal Product Code (UPC), which is used in the US and Canada. The first three digits of an EAN code indicates the name of the company that accepted the registration of the code, and the GS1 website (https://www.gs1.org/) has a searchable database of many (but not all) barcodes.[6]

Food labels may have their own identifying information about the producer for agricultural products and processed foods. In the EU, for example, codes can be found on the product label and consist of a combination of letters and numbers within an oval that can be referenced in an online database.

Various certification labels on the underside of a Philips Hue Bridge.

Certification labels are used to ensure that products are manufactured, produced and traded according to specific standards. As Mario Rautner notes, "they can indicate that the human rights and traditional land rights of local and indigenous people are observed or that no tropical forests are cleared to make a specific product. Well known certification schemes include those for organic and fair trade produce or for sustainable timber, palm oil or coffee."[7] They can also indicate testing standards, safety compliance, and suggest various oversight organizations who warrant certain capabilities regarding the product.

Material testing and analysis can be conducted on objects. Metals, plastics, and other materials can be identified—and in some cases traced to their origins—through scientific testing. This is particularly valuable when sources are diluted through processing and difficult

to trace. DNA testing of wood, for example, has been used successfully to detect illegal timber sourcing.[8]

Data from Actors

Worker Collaboration offers access to one of the most valuable sources for information on a supply chain—the workers caught up in it. While their knowledge is still partial, workers at various tiers of the supply chain possess individual understandings that would be difficult for an external investigation to uncover. They also—almost uniquely—have the potential to gather new information in response to specific goals and objectives. This is not without risk. Workers sharing information about "their" supply chain are possibly (even probably) revealing confidential information about partner relationships, inventory numbers, factory procedures, and so on. In some countries there may be "whistleblower" protections in place, but precarious workers may not be able to take advantage of them. Even in countries where protections exist, this is rarely effective at shielding workers from retaliatory behavior.[9] Still, workers might have good reason for documenting their experience of the supply chain, for example by supporting organizing efforts that protect their rights, help them bargain for fair wages, and hold companies accountable for the impact of their supply chains on local communities—and external researchers can be useful as facilitators in this process. Regardless of the motivations for worker collaboration, however, a single informant is rarely sufficient—collective knowledge is necessary to understand the scale of the supply chain.

> Supply chains are social networks. They are not only comprised of machines and materials, but lives and livelihoods. The individuals who work in the factories and drive the trucks together possess the collective knowledge of the supply chain's operations.

There are a number of strategies one might use to begin collaborating with workers (assuming one has established some initial connections). The Garment Supply Chain Education Pack, for example, suggests organizing a group participatory exercise that asks "trigger questions" to reveal what workers know about their own workplace.[10] These questions might include: What is the name of the company your work for? Who owns the company you work for? Where do materials come from? Is work going out from the local factory to other factories and/or labor networks? Where do the goods go when the leave the local factory? Are they going to any particular countries or companies? Whose labels are on the goods? Who are the workers in the factory, where do they live, what are their circumstances? These questions need not exist in a vacuum. If the interest of the workers is in organizing, for example, to what end? What is their purpose in knowing more about the supply chain? How could it be useful for improving their circumstances, the lives of others, or broader society? Later questions might include: Where can we look for information? And, of course: Who else can we ask?

Answers to some of these questions may be more readily available than one might imagine. The names and addresses of companies—partners, suppliers, customers—may be written on packages arriving or departing the workplace, or they may be included on signs or in documents—letters, receipts, orders—along with information like part numbers, quantities, and prices. Other employees—such as office workers or colleagues in other departments—could be asked to supply information they have access to. Workers may even be able to

observe visitors from partner companies or overhear conversations. But even when this information is openly posted, it is likely still confidential or proprietary. Workers should be aware of the risks of overtly signaling their efforts—writing things down or entering details into a phone, for example. As we have already noted, investigators have an ethical responsibility, and they should be cautious about advocating for workers to engage in actions which may be illegal, or which could impact employment or aggravate working conditions. In any case, researchers should inform workers of potential repercussions for these investigations.

Worker Forums and Social Media can provide connections where direct access to workers might be difficult, unfeasible, or where it may simply be more expedient to connect with them through social media or over digital communication technologies. This may especially be the case for logistical gig workers—where there is no central location to find workers, or when one is studying logistical processes that span multiple geographies. Forums like Reddit, for example, may offer groups (like https://www.reddit.com/r/AmazonFlexDrivers/) where workers share stories (and frustrations) about their jobs, ask questions (and receive answers) about norms, procedures, and expectations, or provide other kinds of details about their experiences. Sites like https://www.glassdoor.com/ can provide structured reviews and job details, and social media like Facebook, Instagram, or Twitter/X can also be useful tools for building connection—though there is a distinction between dedicated communities (specific Reddits or Facebook groups, for example) and open platforms where relationships are organized through the standard follower model. For these platforms, researchers might find it useful to search by keyword to try to identify particular workers of interest—though it may be difficult to distinguish them from customers or commentators. In other countries (in China, especially) different social media technologies might be used, though researchers may need to possess language skills specific to these regions.

> Digital communication technologies can provide both a passive source of information on how work is conducted and a source for canvassing potential informants for additional contact. But one must be cautious. Many of these forums are public. While they may operate outside of a company's control, this does not mean the company is not accessing them, and workers could face retaliation if their identities are revealed. Companies might even use these sites to spread counter narratives and misinformation. Any direct contact with workers should be vetted, and passive information should be corroborated.

Community Accounts can reveal information on the "edges" of the supply chain, after all, these chains are not only the domain of the corporations who enact them or the shoppers who consume their productions. They aren't even limited to the workers caught up in their global assembly. The supply chain runs through real geographies, real towns, and real communities. The merchants who runs stores where workers top up mobile phone data, or where truckers stop to eat are just some of those other actors bound up in the business of global supply. Connecting with these people—through observation, ethnographic encounters, and other methods of analysis, can expand the chain from a collection of nodes to communities populated by thousands of lives.

Data from Publications

Press releases are official announcements by organizations or companies to inform the media and the public about a particular event or notable development. These announcements are often used to launch a new product or to notify the public about acquisitions, partnerships, financial results, or other corporate milestones. In supply chain investigations, press releases can provide information about a company's relationships in industry, sometimes providing the only readily accessible evidence connecting a firm to particular partners or suppliers, or the only documentation of a company's presence in a specific geography of operation. Because—unlike a company's web site or self-hosted reports—they are published and widely disseminated, these documents offer hard evidence of a firm's statements regarding a particular development.

> Publications, especially corporate publications, can offer critical insight on the supply chain, detailing where products come from, how they are manufactured, the names of suppliers and partners, and so on. Care must be taken, however, regarding the agenda behind publication.

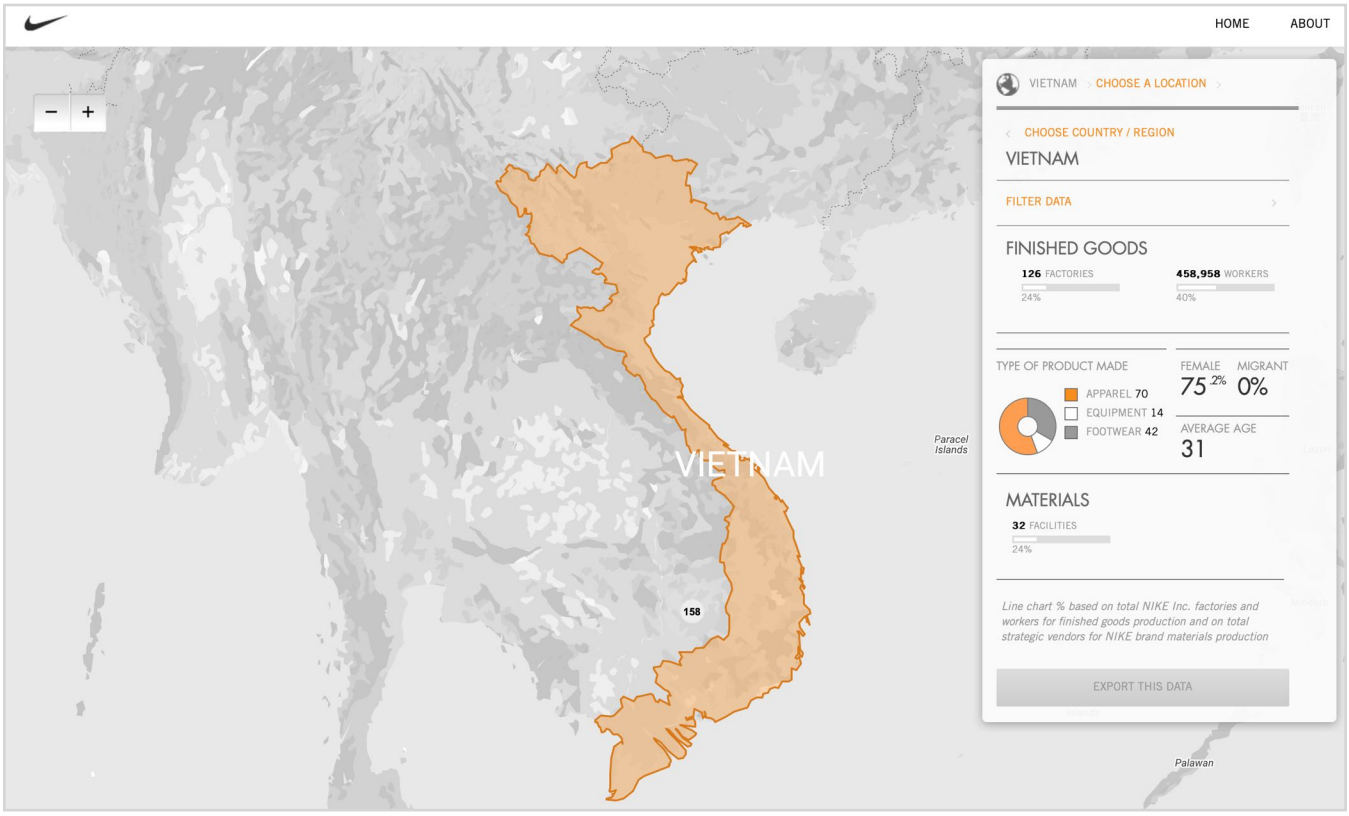
This wide release makes these documents readily accessible. To find them one need only conduct a web search for the name of the company, "press release," and any other relevant information.

Sustainability reports are corporate-published documents that provides information about a company's sustainability practices, performance, and impacts. They usually outline the organization's efforts to integrate sustainable practices into its operations, often emphasizing the environmental footprint of its products (those these reports may also include details on economic and labor conditions, recycling initiatives, and similar efforts). Companies will disseminate these reports for their own internal uses, but will often publish them on their websites. The reports frequently include details on company goals, corporate logistics, suppliers, and environmental impacts, generally presented with graphs, statistical data, and maps, and also with photographs, quotes, and interviews. While there are repercussions for misrepresentation in these reports, there are fewer requirements concerning the omission of information. Sustainability reports, in other words, can be partial—they can be sampled to include only a portion of the supply chain, and they will make every effort to present the company in a positive light. They also tend to be future-oriented documents, with a somewhat selective focus on past comparisons for a company's sustainability measures. Depending on the company, these reports may be singular, all-inclusive documents, or they may be divided among various different specialized reports. Supplier responsibility reports, for example, are often separate documents.

In some countries, this reporting is governed by law, depending on the size or status of the company. In the US, for example, The ESG Disclosure Simplification Act requires public companies disclose certain environmental, social, and governance matters annually in their filings with the Securities and Exchange Commission, though these formal disclosures are not always exactly the same as those presented in the more glossy public sustainability report (though they cannot contradict each other).[11]

Like press releases, these are usually accessible by performing a web search for the name of the company and something like “sustainability or impact report.” Finding old reports may be difficult, and tools like the Internet Archive’s Wayback Machine may be valuable in recovering them.

Supplier reports are related to sustainability reports. Some companies will publish detailed overviews of (usually a portion of) their suppliers. This may include promotional “features” on particular suppliers, or it may be an aggregate assessment of how suppliers are meeting company goals around labor or economic standards. This sometimes includes maps at various levels of detail. Nike, for example, publishes https://manufacturingmap.nikeinc.com/ which includes a country-level breakdown of their manufacturing suppliers. The map is organized by product category and shows the number of facilities, gender ratio, migrant labor ratio, the total number and average age of workers, and so on. The map data can also be exported, where it is broken down by specific supplier, complete with name and address.



Nike Manufacturing Map, showing detailed view of Vietnam (https://manufacturingmap.nikeinc.com/).

Marketing materials include a wide range of documents intended to advertise or detail products for consumer purchase or business acquisition. This can include more traditional video, audio, or print advertisements, but it can also include ancillary materials like product installations at conventions, trade shows, or public events, interviews with designers, developers, engineers, and executives, behind-the-scenes features on factory or production operations, and so on. New (and sometimes not-so-new) companies frequently make use of crowdfunding platforms like Kickstarter to launch products. Because of need to solicit investment capital, these will often include far more detailed discussions, videos, plans, and diagrams about a product’s manufacturing designs, potential suppliers, etc. then would

normally be available. In any case, while some of these marketing materials may be quite limited in scope—a thirty-second television advertisement or single magazine page—others can be extensive features that can provide insights into the product supply chain.

One must be cautious, however, in interpreting information provided by marketing materials. While substantive falsehoods are usually prevented by law, subtle manipulations—in presentation, framing, omissions of critical details—will be present. At the very least, these materials usually contain a clear agenda to present the product in the best possible light so as to motivate and entice consumers.

Product documents are publications related to specific products. Some of these may be addressed to consumers. This includes things like user manuals (which could contain information about product assembly), details related to care and function, part and assembly guides (with part diagrams or replacement information—potentially including contact and address information for companies, partners, and service centers).

Some products may have repair guides that offer more detailed information on the operations of specific parts, or more detailed part replacement guides. Generally speaking most consumer products, outside of large household appliances, no longer have these guides readily available—though that does not mean they don't exist. It used to be the case that almost every electronic device sold to consumers had a repair guide, wiring or electrical schematic, and similar sorts of documents (sometimes bundled with the general documentation included in the purchase). In other cases, these were available only to authorized or general repair technicians. With the decline of repair and maintenance options in many sectors, these are less frequently available.

Other documents, like bills of materials, may also be available for a product—either as an official corporate publication or produced through an aftermarket repair industry. Given the global transformation of production over the last fifty years, these documents may be available only in the region of product manufacture or other global commodity centers. This means that they could be available in languages outside of the target consumer market (products sold in the United States may have this documentation available only in Chinese, for example).

Supplemental publications like electrical schematics or a bill of materials can sometimes be acquired on various web sites that republish or collate this information—though not necessarily for free. Unauthorized reconstructions of bills of materials are sometimes components of teardown and other object investigations (on sites like https://www.ifixit.com/ for example). In other cases, traveling to repair / component market locations may be necessary to gain access to these documents, or intermediaries may be able to acquire these documents (usually for a fee). In some cases, such as for documentation from China, investigators may need to operate through a platform like WeChat).

Trade Journals, along with specialized magazines, and newspapers can offer critical perspectives on the logistics industry. Supply Chain Quarterly (https://www.supplychainquarterly.com/) for example, offers a range of articles, research papers, case studies, and industry insights that deliver information on emerging trends, best practices, and current strategy for supply chain management. For more a scholarly resource, the

International Abstracts in Operations Research (https://iaorifors.com/) is the literature search tool for operations research, supply chain, and management science research.

White papers are reports published—usually by various institutes, consulting firms, and industry associations. Depending on the research topic, relevant white papers may be useful starting points, sources of industry insight, and overviews of particular topics. See for example, reports published by PwC (https://www.pwc.com/gx/en/industries/transportation-logistics/publications.html) and Deloitte (https://www2.deloitte.com/us/en/pages/operations/solutions/supply-chain-strategy-operations-services.html)

Data from Records and Databases

Corporate filings and records kept by government institutions usually includes formal filings like incorporation documents, yearly reports, or various notices associated with taxes or liability. Similar basic corporation information can also be found on sites like opencorporates.com or craft.co, while third-party services like glassdoor.com, comparably.com, careerbliss.com can provide more specialized information like job positions and salaries. Specific initiatives, like https://id.occrp.org/ may have targeted databases with a wealth of data—in this case providing reference points for companies, individuals, or properties mentioned in the OCCRP's organized crime and corruption reports and datasets.

Directories offer listing of corporations, facilities, people, organizations, and other resources of relevance to many supply chain investigations. Source like https://www.fleetdirectory.com/, for example, promise an online directory of links to "trucking, transport, logistics and industry-related company websites, with similar resources including sites like http://www.logisticsworld.com/ and http://www.loglink.net/.

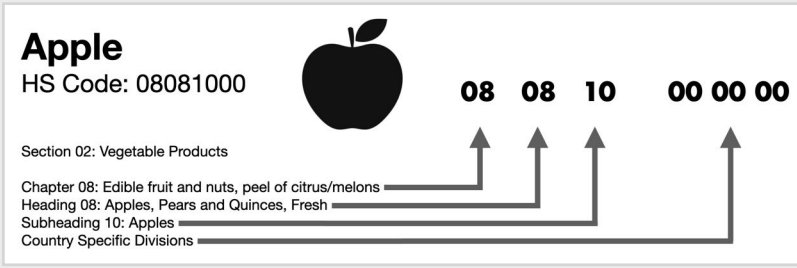
Surveys and statistics are often kept by governments and other organizations that may have aggregate information relevant for supply chain research, including statistics produced due to regulatory oversight. For example, several Federal Reserve Banks collect periodic surveys of the manufacturing industries in their region (for example: https://www.newyorkfed.org/survey/empire/empiresurvey_overview.html), while the US Department of Transportation keeps statistics on Air Cargo (https://www.transtats.bts.gov/freight.asp).

Other legal records kept by governments include more general information for investigations concerned with cities (such as city registries like https://a836-acris.nyc.gov/CP/), or those which require access to court filings (such as those provided by https://www.courtlistener.com/) or specific details on international law (such as https://archives.nato.int/). It also includes patent information (https://www.uspto.gov/patents/search), which can offer detailed information on product components and operation.

Governments collect large amounts of data about their constituent geographies and industries. Any object that crosses a border surely has a government record associated with it, and any operation that is regulated has some agency responsible for reports regarding those regulations. Where government records are more limited or difficult to access, NGO databases and various third-party services can also provide detailed (if less reliable) sources.

Spatial data includes mapping information, information on natural features like forests or waterways, and land-use data related to topics like agricultural or industrial zoning. It may include environmental information, or climate data (weather patterns, flood records, and so on). Some of this data may be collected because of particular mandates at local, national, or international levels, while other collection efforts may be project driven—collected in preparation for specific public/private infrastructure projects like the building of roadways, railways, or dams, for example. Third-party sites that build on existing spatial knowledge can be useful resources as well. Trace and Traceability's Mine Tracker (https://trace-and-traceability.org/MineTracker.php), for example, records a list of known mining sites (as well the the primary minerals extracted).

Shipping or trade data can be extremely valuable in investigating global logistical flows. While some of this data is collected by private companies, significant sources of data involving ship or port activity, customs records, and aggregate trade statistics are kept by governmental sources. Depending on the country, this data may be publicly available (though it may be expensive or difficult to access). This includes customs information, such as the information provided by https://comtradeplus.un.org/ or https://www.wcoomd.org/en.aspx) and (in the US) the detailed records provided by third-party sources like tradeatlas.com, importgenius.com, xportmine.com, importyeti.com, and panjiva.com. Export information and controls for Europe are provided by TRACES (https://webgate.ec.europa.eu/tracesnt/directory/publication/establishment/). Some ship information (including movement records) can be found on various third-party sites like marinetraffic.com, shipfinder.co, shipspotting.com, and vesseltracker.com. Rail and highway information may be available also, for example https://stb.maps.arcgis.com/home/webmap/viewer.html?webmap=96ec03e4fc8546bd8a864e39a2c3fc4 shows US rail network lines.



The HS Code system (https://www.trade.gov/harmonized-system-hs-codes) is an internationally standardized system of names and numbers used to classify goods for import and export.

Assumed Data

Assumptions are not data. Of course not. But at the same time, reasonable assumption can be valuable tools in furthering supply chain investigations. These are some examples of the kinds of assumptions we commonly make in supply chain investigations (and why):

Known supplier relationships: If you know a company works with a supplier that is known to manufacture plastics, but you don't know if this supplier make the plastic for the particular product you are investigation, if may still be justifiable to infer a reasonable likelihood that they are the supplier. After all, even if they aren't, they easily could have been, and there is a high likelihood that the "real" supplier would be a similar sort of company in terms of productive capability, market position, etc.

Generalization to industry: If things are commonplace in a particular industry, it might be reasonable to start with these generalizations. For example, if you are looking at consumer electronics sold in the United States, it might be reasonable to assume final assembly in China until you know otherwise. From there, it would follow that distribution includes ocean shipping to the West Coast (Long Beach) and trucking transport to large local distribution hubs (like Elizabeth NJ).

Market leaders: If you know that a company is the market leader for a particular material or component, and you can't find any specific evidence of a more specific supplier, you might assume that the market leader is the supplier until you find otherwise. Sometimes this can be very likely, with some companies making 70, 80, or even 90% of certain components in certain markets. Of course there is a change that your supply chain isn't covered by the 90% —but it is a useful placeholder and a good starting point.

Additional Resources

This section presented only a small, general range of the kinds of data sources that are available for conducting supply studies research investigations. It is completely reasonable that some researchers will make use of other—often highly specific—sources in their work. For more information on potential data sources, please visit the Supply Studies Research Network (https://supplystudies.com/research-network/).

Notes

[1] Glenn A. Bowen, “Document Analysis as a Qualitative Research Method,” *Qualitative Research Journal* (2009).

[2] “Ethnographic Research Protocol,” University of Virginia (https://hrpp.research.virginia.edu/teams/irb-sbs/researcher-guide-irb-sbs/ethnographic-research).

[3] John Kelleher and Brendan Tierney, *Data Science* (Cambridge: MIT Press, 2018)

[4] See, for example, the work of the Helena Kennedy Centre Forced Labour Lab (https://www.shu.ac.uk/helena-kennedy-centre-international-justice/research-and-projects/all-projects/forced-labour-research).

[5] See, for example, the work of the Logistical City project (https://logistical.city/).

[6] See: https://www.gs1.org/standards/barcodes/ean-upc and http://gepir.gs1.org/index.php/search-by-gtin.

[7] Mario Rautner, "Supply Chain and Product Investigations," *Exposing the Invisible: The Kit*, https://kit.exposingtheinvisible.org/en/supply-chain.html.

[8] David Fogarty, "DNA tests tell trees from the wood; curb illegal logging," *Reuters* (August 19, 2012).

[9] "Whistleblower Protections," US Department of Labor (https://www.dol.gov/general/topics/whistleblower).

[10] Delia Mather, “Garment Supply Chain Education Pack” in Garment Industry Supply Chains: A Resource for Worker Education and Solidarity, Women Working Woldwide (2004).

[11] See https://makersite.io/insights/sustainability-reporting-us/ and https://www.congress.gov/congressional-report/117th-congress/house-report/54/1

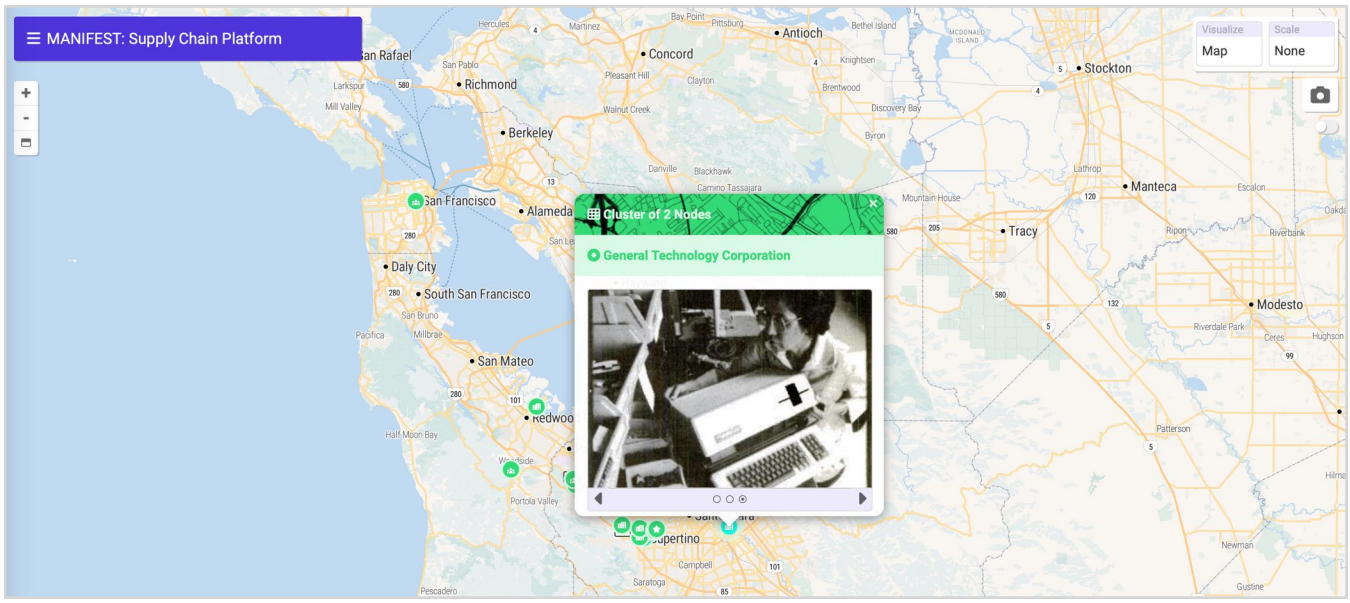
V. Case Studies

This section presents a series of case studies that demonstrate a variety of supply studies investigations, from historic to contemporary, narrative to quantitative.

Each case is described briefly along with the names of the investigators, the primary goal of the investigation, its type (as described in chapter 2), and a link to the Manifest document produced for the investigation.

Apple Factory History

Matthew Hockenberry, Idsel Rosas, and Karina Garcia, Fordham University



manifest.supplystudies.com/manifest/samples/apple-factory/

Goal: The goal of this project is to construct a historical overview of Apple's manufacturing, with an emphasis on the changes in factory and office infrastructure, their configuration, and the experiences of workers in these facilities.

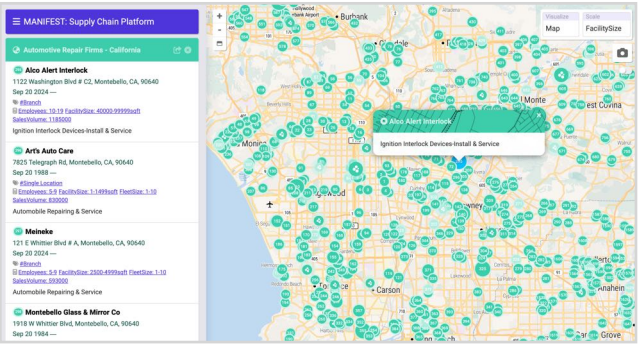
Narrative, Historic

This case study documents the manufacturing history of Apple Computer. While Apple is often associated with manufacturing in places like China, the company has a longer and and more complicated history with production. Over the past forty years, Apple went from owning its own facilities in California to offshoring to companies based thousands of miles outside Cupertino. In examining the history of Apple's assembly, this investigation looks to demonstrate that many of the causes of the modern supply chain—the problematic labor practices, the environmental abuses, the human rights allegations—are deeper than the symptoms we see in outsourced partnerships with firms like Foxconn and Pegatron. For Apple, they stretch back to the beginning of the company—with contemporary concerns find analogs decades earlier. The company has both resisted trends and exemplified them, struggling with an almost pathological need for the control production while simultaneously surrounding that control in pursuit of profit. In the end, it has become something of an emblem for supply chain capitalism.

This investigation uses the Manifest platform to map Apple's factory locations and major office facilities, as well as those of related companies like NeXT Computer and Foxconn. For each location it constructs a timeline of major events using archival images and the accounts of actors at the time. This is not as easy as it might seem. Despite their recency, documentation on details concerning product lines—even the addresses of locations—are sometimes difficult to come by.

Automotive Repair Firms in CA

Bridget Wack, Researcher at International Longshore and Warehouse Union (ILWU).



manifest.supplystudies.com/manifest/cases/NEH/wack/

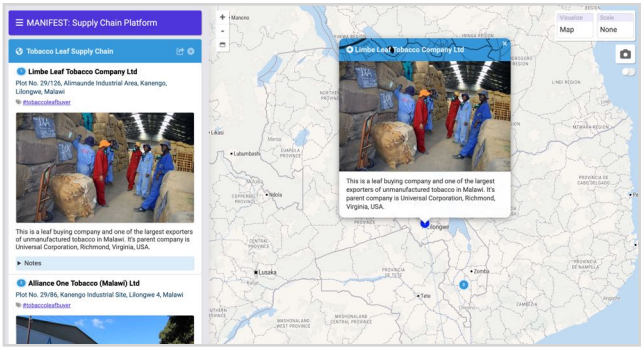
Goal: Organizing data collection of automative repair firms for a campaign in California.

Quantitative, Facilities/Infrastructure

This investigation looks at one particular component of the automobile supply chain—automative repair. It maps over two thousand automative repair companies in the state of California. Each entry for a company includes information on the organization (a single location shop or a branch location) as well as measures for the number of employees, the size of the facility, the fleet size, and the overall sales volume. For the number of employees, facility size, and fleet size, this data is recorded in buckets rather than as raw numbers—though the sales volume is recorded by actual value. This allows some ongoing variance in the data to still be clearly commensurate among similar facilities (two facilities with between 10-19 employees are represented in the same way, regardless of if one has 13 employees and one 18).

The Tobacco Leaf Supply Chain

Marty Otañez, Associate Professor of Anthropology at University of Colorado Boulder



manifest.supplystudies.com/manifest/cases/NEH/otanez/

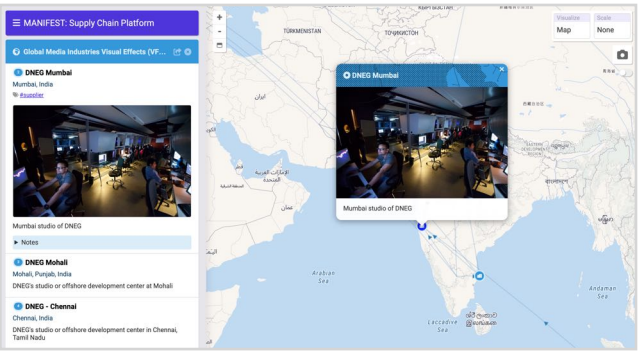
Goal: This project examines the relationship between trade inventories of unmanufactured tobacco leaf and the strategies of global tobacco companies, building on previous research on child labor, debt servitude and corporate social responsibility schemes in Malawi.

Narrative, Upstream/Downstream

This investigation looks at unmanufactured tobacco leaf exports from Malawi, Africa, with a focus on the top five countries that receive exports. The supply chain begins in Lilongwe, Malawi, where tobacco arrives from farms in different regions in the country. In Lilongwe, several cigarette leaf manufacturers including US-based Universal Corporation and Alliance One International purchase leaf through pre-arranged contracts with local farmers. Leaf buyers process the tobacco and prepare it for shipping by removing the stems from tobacco leaves. Unmanufactured tobacco is shipped in containers and transported from Lilongwe to ports in Mozambique and South Africa before it is sent to Belgium, Germany, Poland, Egypt and the US to be received by British American Tobacco, Philp Morris, or Japan Tobacco and processed into cigarette brands such as Marlboro and Camel and ultimately delivered to distributors, retailers and consumers.

Global Media Industries Visual Effects

Suryansu Guha, UCLA



manifest.stupplystudies.com/manifest/cases/NEH/guha/

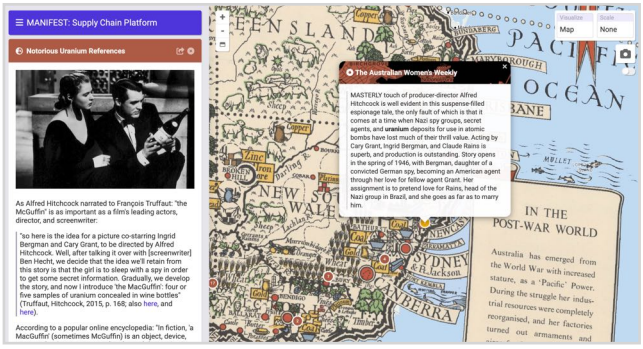
Goal: This investigation attempts to examine the global pipelines of VFX, asking: What do the global VFX labor supply chains look like when mapped? How can we map these supply chains' constant readjustment to specific highly constituted projects?

Supplier/Client

This investigation explores the work of creating digital visual effects in film and entertainment, an often laborious post-production process that is highly routinized and often outsourced. It focuses on "multinational visual effects houses" or "visual effects studios," in particular DNEG, a British-Indian visual effects, computer animation and 3-D conversion studio that was founded in 1998. Originally named Double Negative, this boutique studio was based in the UK. In 2015, an Indian Conglomerate bought Double Negative. Under the name DNEG, the company opened offices in Vancouver and Sydney, India, the United States, and elsewhere. The investigation considers the various locations for DNEG's studios or offshore development centers across the globe. There is no clear information about which location is DNEG's headquarters. Most importantly, there is no clear information about labor trajectories, such as who outsources to whom. Since projects in this industry are highly customized and outsourced, VFX labor supply chains often change their directionality. For example, if the project comes from Hollywood, the supply chain will start in the Los Angeles Office, and the labor will mostly come from the UK.

Notorious Uranium References

Elizabeth Bishop, Associate Professor of History, Texas State University



manifest.supplystudies.com/manifest/cases/NEH/bishop/

Goal: This investigation explores references to Uranium in media centered around the Alfred Hitchcock film, Notorious, to reveal geographic insights around awareness of the material.

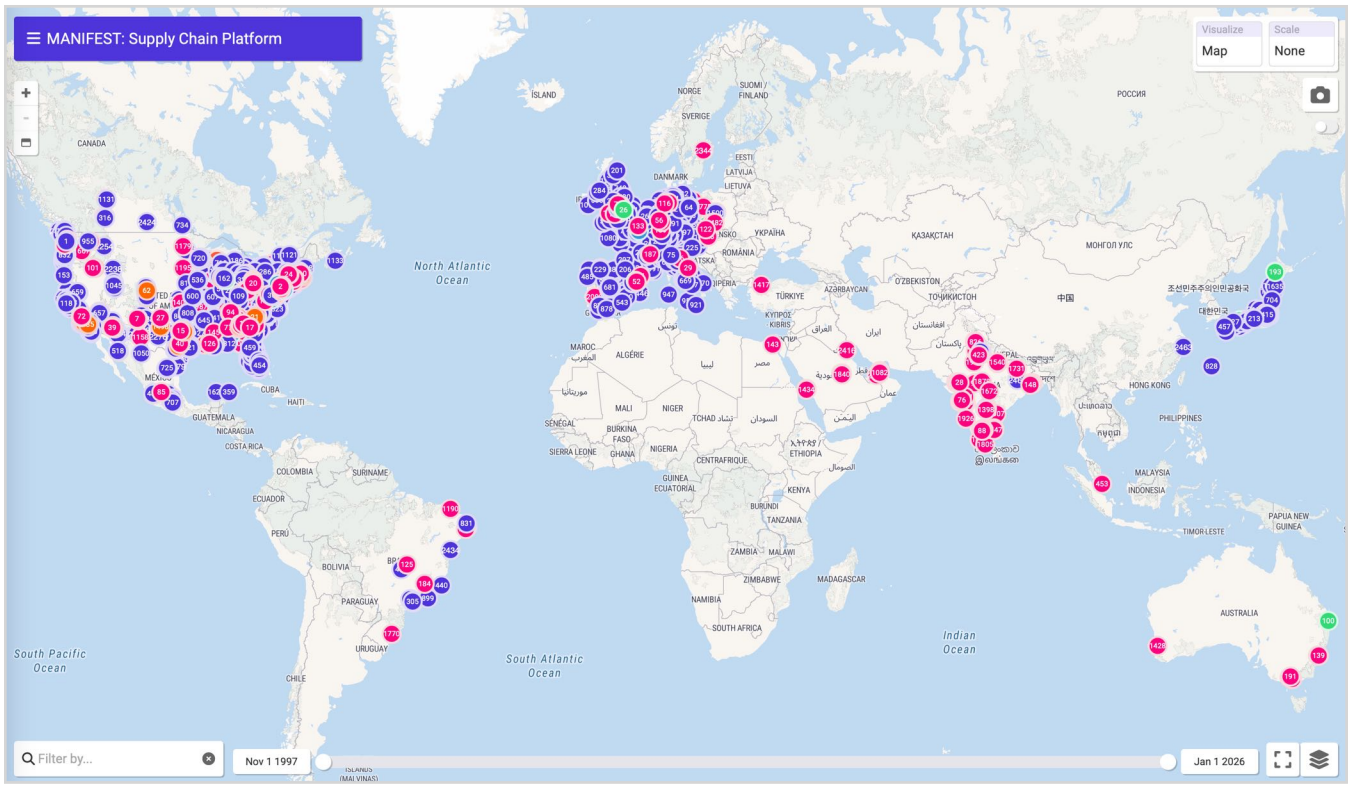
Narrative

> "So here is the idea for a picture co-starring Ingrid Bergman and Cary Grant… we decide that the idea we'll retain from this story is that the girl is to sleep with a spy in order to get some secret information. Gradually, we develop the story, and now I introduce 'the MacGuffin': four or five samples of uranium concealed in wine bottles."[1]

In fiction, a MacGuffin is an object, device, or event that is necessary to the plot and the motivation of the characters, but insignificant in itself. Its sole purpose is to provide motivation. As Hitchcock told Truffaut: "if it had not been a wartime story, we could have hinged our plot on the theft of diamonds, the gimmick was unimportant." Critics agreed: throughout the Anglophone world, only one review of "Notorious" even mentioned uranium. Except in the place with the world's largest uranium reserves. While the Australian Broadcasting Act of 1942 prevented unguarded talk pertaining to strategic materials, critics reviewing "Notorious" for small-town newspapers in Australia noticed uranium as frequently as Ingrid Bergman and Cary Grant. This investigation explores how under these specific circumstances, the "MacGuffin" became notable.

Amazon Infrastructure

Manifest Team



manifest.supplystudies.com/manifest/samples/amazon-infrastructure/

Goal: This project presents Amazon's infrastructure and facilities, categorizing them into specific (company designated) functions.

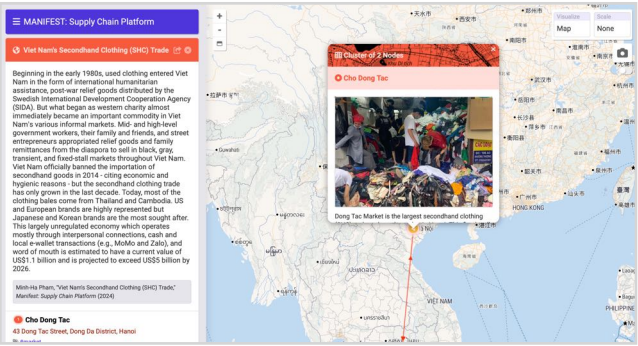
Quantitative, Facilities/Infrastructure

This investigation attempts to map global infrastructure and facilities for Amazon. It includes fulfillment centers, sortation centers, delivery centers / delivery stations, inbound and outbound cross dock centers, and Amazon Fresh, Amazon Pantry, and Wholefoods locations, with facility color coded and presented on a Manifest document. It also includes the opening date and planned (but not yet built) facilities. The size of the facility (when available) is also recorded (along with any additional observations or notes), and viewers of the Manifest are able to visually compare facility size.

> Our fulfillment network is made up of state-of-the-art technology and a variety of building types and sizes to support processing orders… Many Amazon FCs span the equivalent of 28 football fields and can hold tens of millions of items on any given day. Yes, tens of millions. The scale of the centers can be difficult to grasp, even in person…[2]

Viet Nam's Secondhand Clothing Trade

Minh-Ha Pham, Professor of Media Studies, Pratt Institute



manifest.supplystudies.com/manifest/cases/NEH/pham/

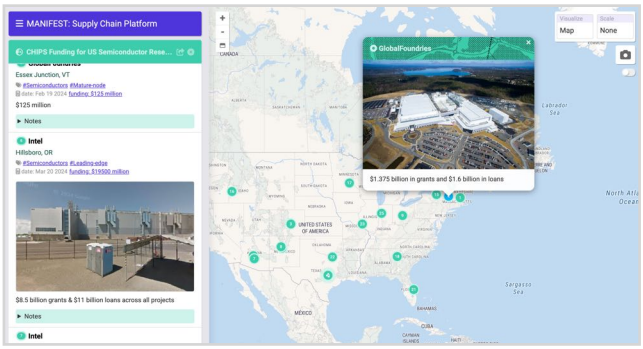
Goal: This investigation examines the illegal trade in secondhand clothes in Vietnam

Narrative, Category/Sector

Beginning in the early 1980s, used clothing entered Viet Nam in the form of international humanitarian assistance, post-war relief goods distributed by the Swedish International Development Cooperation Agency (SIDA). But what began as western charity almost immediately became an important commodity in Viet Nam's various informal markets. Mid- and high-level government workers, their family and friends, and street entrepreneurs appropriated relief goods and family remittances from the diaspora to sell in black, gray, transient, and fixed-stall markets throughout Viet Nam. Viet Nam officially banned the importation of secondhand goods in 2014—citing economic and hygienic reasons—but the secondhand clothing trade has only grown in the last decade. Today, most of the clothing bales come from Thailand and Cambodia. US and European brands are highly represented but Japanese and Korean brands are the most sought after. This largely unregulated economy which operates mostly through interpersonal connections, cash and local e-wallet transactions (e.g., MoMo and Zalo), and word of mouth is estimated to have a current value of US$1.1 billion and is projected to exceed US$5 billion by 2026.

CHIPS Funding for US Semiconductor Research and Manufacture

Anibel Ferus-Comelo, Director of Community-Engaged Academic Initiatives, UC Berkeley Labor Center



manifest.supplystudies.com/manifest/cases/NEH/afc/

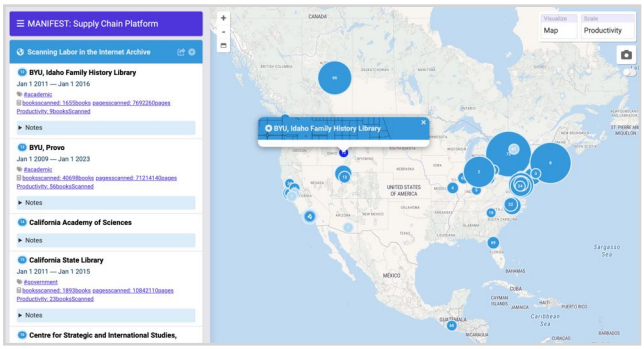
Goal: This investigation considers the investments (and proposed investments) of the CHIPS and Science Act.

Facilities/Infrastructure, Supplier/Client

This investigation examines facilities funded (proposed, pledged, etc.) under the 2022 CHIPS and Science Act. "The 'Creating Helpful Incentives to Produce Semiconductors and Science Act' is designed to boost US competitiveness, innovation, and national security. The law aims to catalyze investments in domestic semiconductor manufacturing capacity. It also seeks to jump-start R&D and commercialization of leading-edge technologies, such as quantum computing, AI, clean energy, and nanotechnology, and create new regional high-tech hubs and a bigger, more inclusive science, technology, engineering, and math (STEM) workforce."[3] While of strategic importance, the large amount of money made available under the law requires scrutiny.

Scanning Labor in the Internet Archive

Elizabeth Schwartz, Lucian Li, and Davíd Satten-López, University of Illinois Urbana-Champaign



manifest.supplystudies.com/manifest/cases/NEH/scanninglabor/

Goal: This investigation looks to document the evolution of labor for book scanning projects.

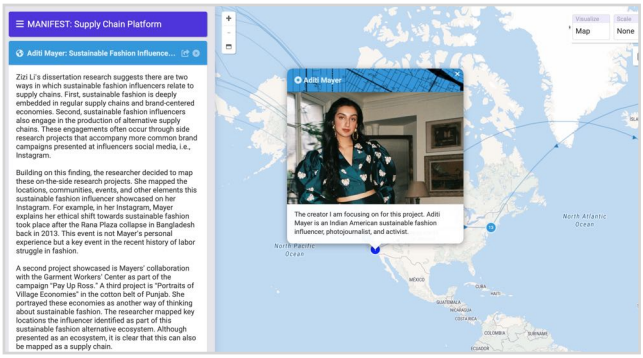
Quantitative, Supplier/Client

This is a spatial-labor history of the book scanning workers who create the world's largest free digital library, the Internet Archive. The Internet Archive announced the launch of its book scanning program 2004. While the Archive highlights some scanning workers and scanning centers on their blog, the process through which books are scanned remains opaque.

This investigation makes visible scanning labor, visualizing 9 million book/text metadata records from 2004 to 2023. Analysis reveals that around 2011 Internet Archive moved from scanning operations from in-house centers at academic libraries in the global north to outsourced firms in the global South. This shift is also associated with a sharp uptake in the number of total books scanned per month and the number of books scanned per worker per day and increasing secrecy surrounding the scanning process. At the same time, worker testimonies indicate that working conditions are poor and surveillance is common. Scanning Labor models how digital humanists can and should use methods to, first, recenter the lives of the people who digitize the data upon which we build projects and, second, to call for more ethical digitization-labor practices and grow a critical digital humanities practice.

Sustainable Fashion Influencer Media Production/Distribution

Zizi Li, UCLA



manifest.supplystudies.com/manifest/cases/NEH/li/

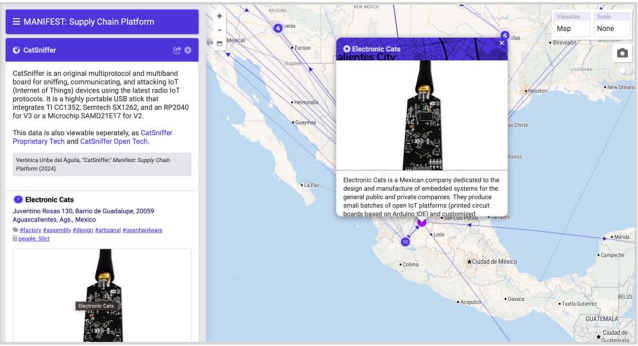
Goal: This investigation explores the sustainable fashion supply chain from the perspective of a sustainable fashion influencer, asking: To what extent do influencers draw on supply chains? How do they build on knowledge workers and other affected communities produced around supply chains? What kind of research on supply chains do these actors produce on their own?

Narrative, Supplier/Client

This investigation explores the ways in which sustainable fashion influencers relate to supply chains. In some sense, sustainable fashion influencers engage in the production of alternative supply chains. These engagements occur through side projects that accompany more common brand campaigns presented in influencer social media. This investigation maps the locations, communities, events, and other elements one sustainable fashion influencer showcased on her Instagram. It also looks at their connection with the Garment Workers' Center as part of the campaign "Pay Up Ross" and the "Portraits of Village Economies" project in the cotton belt of Punjab. The result shows key locations the influencer identified as part of this sustainable fashion alternative ecosystem.

Mapping Open Hardware in Mexico

Verónica Uribe del Águila, University of California San Diego



manifest.supplystudies.com/manifest/cases/NEH/uribe/

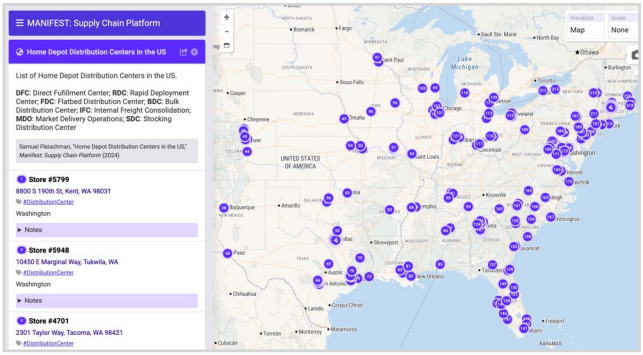
Goal: This investigation examines open hardware in Mexico, asking: How can we map open hardware supply chains that involve proprietary and open networks of innovation? What are the main differences between open hardware supply chains and fully proprietary supply chains?

Narrative, Supplier/Client

This investigation examines open hardware in Mexico mapping the multiple open and proprietary networks in the production of CatSniffer, a multiprotocol, multiband board for sniffing, communicating, and attacking IoT (Internet of Things) devices. The investigation highlights two findings. First, while both open innovation and proprietary supply chains include technology transfer processes, only open innovation supply chains emphasize this aspect of supply chains. Second, while open innovation networks relied heavily on technology transfer, proprietary supply chains operate via technology transfer contracts. It concludes that while production and distribution of supply chains are theoretically global, in practice the design of the board only takes place between the United States, Europe, and Mexico.

Home Depot Distribution Centers in the US

Samuel Fleischman, UCL Institute for Innovation and Public Purpose



manifest.supplystudies.com/manifest/cases/NEH/fleischman/

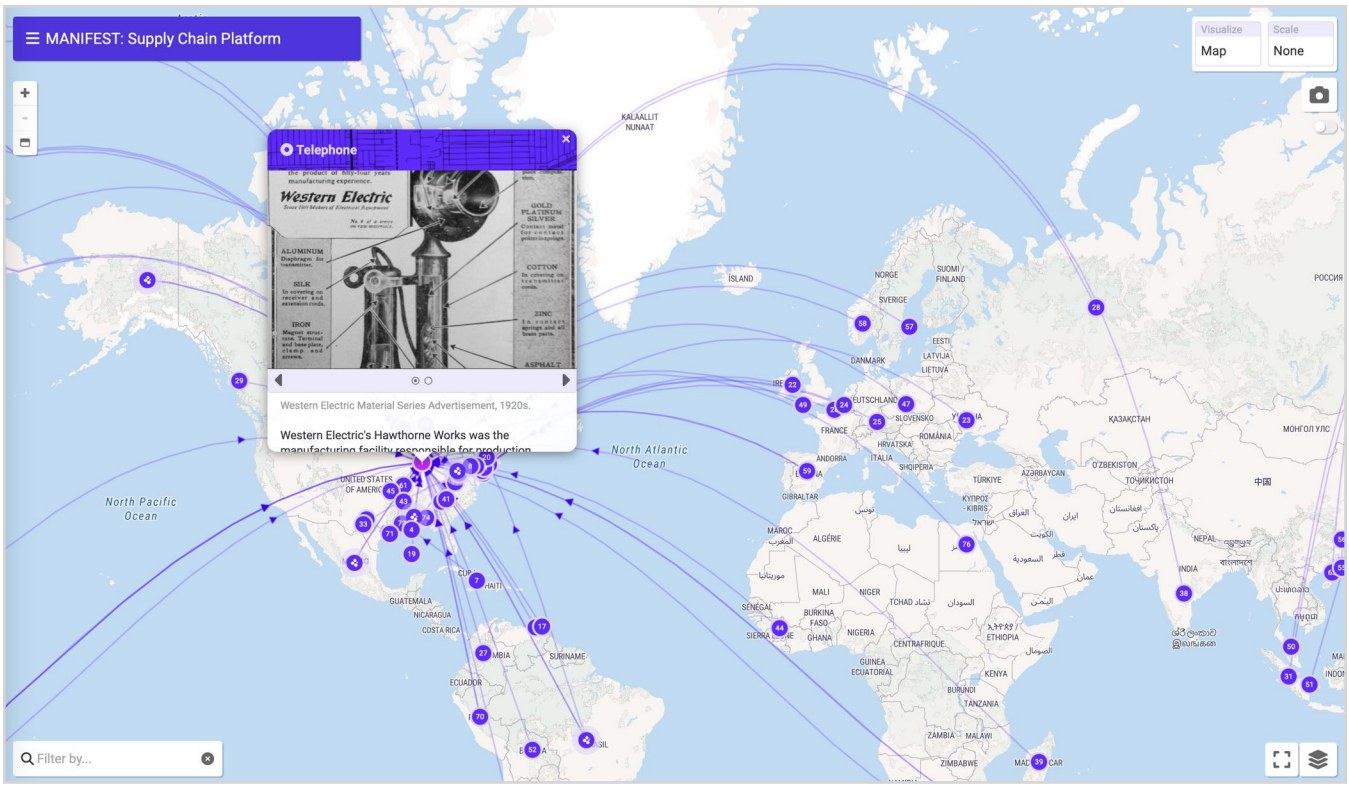
Goal: This investigation looks at Home Depot distribution centers in the US as part of an organizing campaign.

Quantitative, Facilities/Infrastructure

This investigation maps home depot distribution centers in the United States as part of a larger research campaign for labor organizing. Collecting over 200 facilities, it organizes each distribution center as a Direct Fufillment Center, a Rapid Deployment Center, a Flatbed Distribution Center, a Bulk Distribution Center, an Internal Freight Consolidation site, a Market Delivery Operations site, or a Stocking Distribution Center.

Western Electric Telephone (1927)

Matthew Hockenberry, Fordham University



manifest.supplystudies.com/manifest/samples/apple-factory/

Goal: The goal of this project is to reconstruct the supply chain—or at least the material composition—of the candlestick telephone.

Narrative, Historic

This investigation attempts a reconstruction of the supply chain for the Western-Electric produced telephones of the late 1920s. The information for this historic investigation is drawn from Western Electric/AT&T archival materials—especially the 1927 document, *From the Far Corners of the Earth*. Unlike the vast number of subassemblies required for a mobile phone today the supply chain of this candlestick-style telephone was heavily centralized at Western Electric's Hawthorne Works. It was also not sold as a product in the same way as contemporary devices— telephones were leased to subscribers, and Western Electric had substantial maintenance obligations for the network and apparatus. The Manifest document produced for this investigation incorporates a large number of quotes from historic accounts and imagery.

Notes

[1] Francois Truffaut, *Hitchcock/Truffaut* (Simon & Schuster, 1985[1966]).

[2] “Our Facilities,” Amazon (https://www.aboutamazon.com/workplace/facilities).

[3] "The CHIPS and Science Act," McKinsey and Company (October 2022), https://www.mckinsey.com/industries/public-sector/our-insights/the-chips-and-science-act-heres-whats-in-it.

VI. Manifest and Other Tools

This section presents an overview of some of the digital tools relevant to supply studies investigations. It places an emphasis on Manifest, our tool for documenting supply chains, and briefly describes some of Manifest's functionality and motivations. While there is certainly no requirement that supply studies investigations make use of Manifest (or other digital tools), we believe that many investigators would benefit from the kind of scaffolding they provide.

Manifest

Manifest (https://manifest.supplystudies.com) is an investigative platform intended for researchers, journalists, students, and scholars interested in visualizing, analyzing, and documenting supply chains, production lines, and trade networks. Professional logistics tools developed by companies like SAP, Oracle, and IBM are incredibly complex, suited to global networks with hundreds of suppliers in dozens of countries. These systems interface with numerous data sources, with powerful capabilities for controlling the world's material distribution in the name of "supply chain management." Manifest is not one of these. Similarly, there are many tools available for detailed statistical evaluation, graph analysis, and geospatial modeling. And while Manifest can work in concert with these tools, its primary purpose is to:

- Provide common data standards for describing and sharing supply chains or other material networks, along with a simple editor modeled on these standards.
- Develop a flexible geospatial viewer for supply chain data that is transparent, interactive, and simple, with support for specialized data views (graph relationships, etc.).
- Support basic analytic tools for evaluating and comparing critical supply chain measures.

The result is a system flexible enough to meaningfully support a variety of different projects advancing the critical study of logistics.

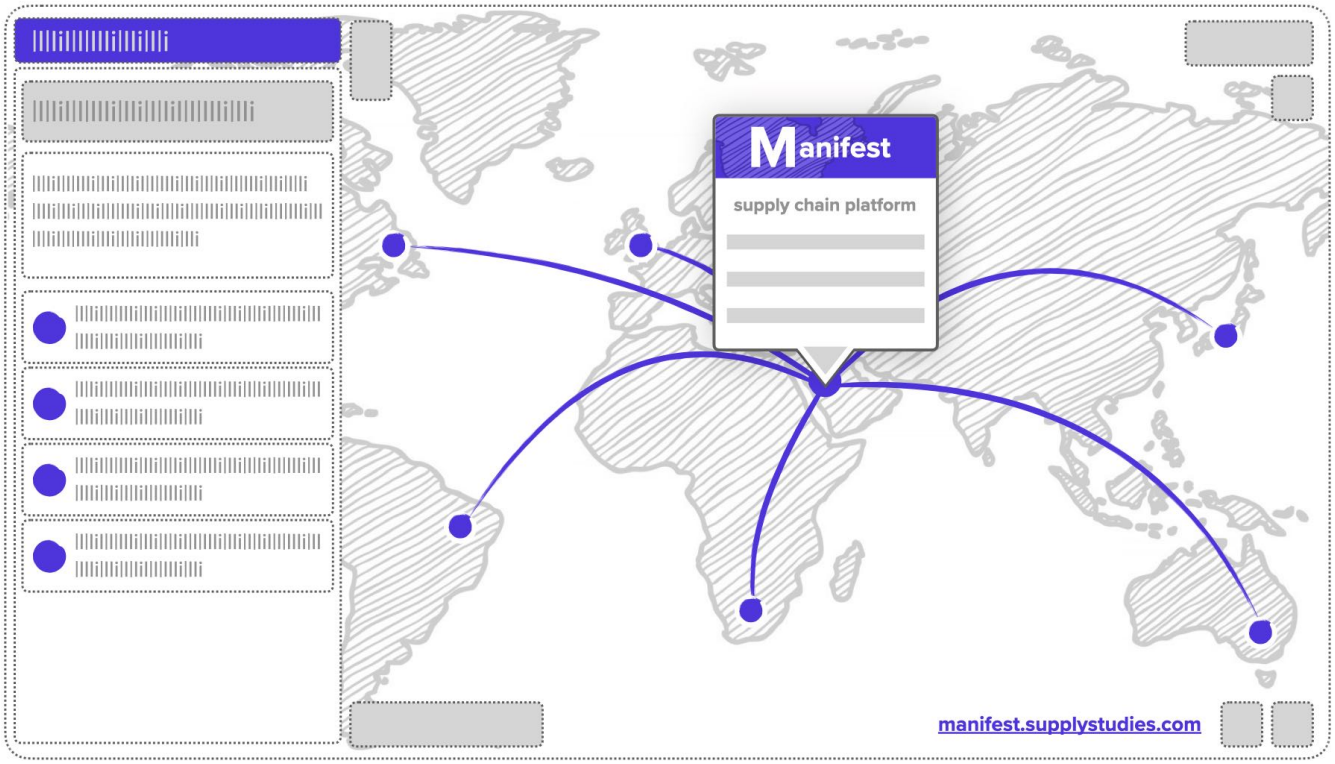


Illustration of Manifest Interface.

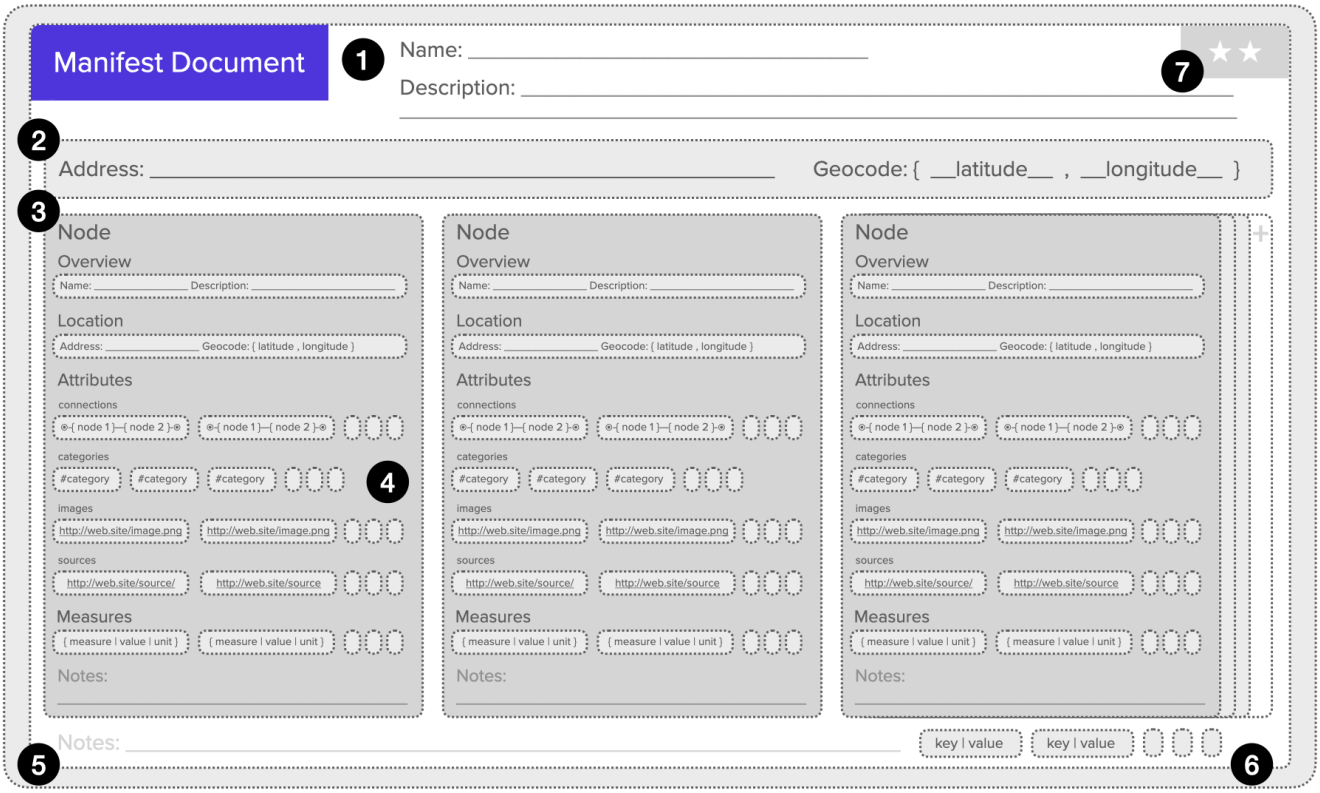
This flexibility is intended to allow someone using Manifest to map high level connections the same way they might catalogue fundamental details, or to include "materials" not normally present in an industrial logistics platform. It also means that Manifest should be as capable of producing rich supply chain narratives as it is facilitating supply chain analysis. In pursuit of these goals, Manifest has been developed with a number of core design principles:

- Manifest is not a database. While we can host Manifest documents and other datasets, the primary workflow for creating and viewing documents happens in the browser, where the Manifest neither sees nor stores the data.
- Supply chains in Manifest are not required to be complete, nor are they limited to discrete and self-contained accounts. The interface was developed to support viewing multiple supply chains (or fragments of supply chains) in order to understand relationships between them.
- Manifest data tends to be descriptive, rather than rigidly structured. The Manifest document format is designed to be open and general enough to contain information across a range of contexts, irrespective of rendering a particular supply chain or particular piece of data.

The goal is a system that rejects the collected and complete in favor of the distributed, the partial, and the temporary.

Manifest Document Format

Manifest is not just a visualization platform, it is a document format for describing supply chains, trade networks, and other logistics systems. At a technical level it describes a JSON files that corresponds to our format. These can be created by hand, in a spreadsheet, or in an editor.



1. **Manifest Overview:** All Manifest documents contain some basic overview information, including a name and a description.
2. **Location:** Manifest documents can also contain a location. This location is associated with the document as a whole (for example, Manifests of products might like the iPhone might use the location for the designing firm--in this case, Apple in Cupertino, California.
3. **Node List:** Manifest documents are primarily a list of Nodes. This nodes presents sites, suppliers, parts, and similar divisions of the supply chain. Each document could have an arbitrary number of nodes.
4. **Nodes:** Each node contains an overview that includes names, descriptions, and similar details; locations, the address that geographically represents the node; lists of: other nodes that node is connected to, categorizations for the node, quantitative measures for the node, images associated with the node, and sources for the information about the node.
5. **Notes:** Documents can contain additional notes that will not be used by the web app.
6. **Key-Value Pairs:** Documents can also contain an arbitrary number of key-value pairs.
7. **Meta Info:** Manifest documents can also contain meta information used by the Manifest web app (describing preferred styling and similar sorts of information).

Manifest for Supply Studies

One of the reasons we created Manifest was to support supply studies research. Because an investigator remains in control of their data at all times, Manifest provides a useful working environment for collecting and visualizing supply chain data throughout the course of an investigation. While Manifest offers a basic editor, most users make use of Google Sheets for maintaining data (see: https://github.com/hock/Manifest/wiki/3.-Creating-Manifests-in-Google-Sheets). This comes with some privacy implications and may not be useful for sensitive investigations, but it provides an accessible and collaborative environment for collating data. Once an investigation is over, Manifest can also provide a publishing environment for results. For more information, see the Manifest Wiki (https://github.com/hock/Manifest/wiki).

Other Tools

Of course, Manifest is not the only tool that could be used in a supply studies investigation. Researchers may benefit from various tools and platforms for managing and collaborating with datasets, producing models and analysis, and visualizing data as charts, graphs, and maps.

Mapping Tools

> **Maptive** (https://www.maptive.com/) is a cloud platform that produces geocoded map data, with route optimization, categorization, and census data overlays.

Professional Supply Chain Tools

Most professional supply chain tools are of limited use to supply chain investigators. They are expensive, difficult to access, and require a large working data set to meaningfully operate. Still, they sometimes provide specific tools and capabilities that can be valuable in certain circumstances, and some offer demos or other forms of limited access. Generally speaking, most provide data connection capabilities to various actors and other systems, a range of customized analytics dashboards, and support for basic visualization techniques (graphs, maps, etc.). Increasingly, they also make use of AI and digital twins to provide predictions and insights into supply chain operations. This section presents a list of some of these professional tools. This list is far from exhaustive, and it is intended only to provide a representative range of platforms with regard to capability, cost, and customer type.

> **Arviem** (https://arviem.com/) provides tools for tracking cargo shipments, connecting shipping containers, cargo, and vessels to a cloud-based analytics platform offering real-time notifications.
>
> **Inetsoft** (https://www.inetsoft.com/solutions/supply_chain_dashboard_reports) provides a supply chain dashboard tool to monitor and analyze supply chain data like inventory levels, production metrics, and supplier performance.
>
> **Panjiva** (https://www.spglobal.com/marketintelligence/en/solutions/panjiva-supply-chain-intelligence) provides users with data, analytics, and research to better understand global

trade. It provides customs data and other reports on potential trading partners and suppliers.

Cambridge Intelligence (https://cambridge-intelligence.com/use-cases/supply-chain/) offers spatial and temporal visualization tools to uncover supply chain bottlenecks, merging real-time data with maps that highlight supply chain inefficiencies.

E2Open (https://www.e2open.com/) is a cloud-based platform that connects and manages a supply chain's manufacturing, logistics, and distribution processes, with support for real-time monitoring and risk, quality management, and forecasting assessment.

Magaya (https://www.magaya.com/magaya-supply-chain/) provides supply chain management solutions including shipping/freight management, warehouse management, and productivity.

Sisense (https://www.sisense.com/solutions/supply-chain-analytics-software/) provides analytic dashboards that can be used to assess workflow and potential risks.

Sourcemap (https://www.sourcemap.com/) is a visualization platform that provides supply chain analysis to help companies manage, assess, and optimize their supplier networks.

Blue Yonder's Luminate Logistics (https://bluegistics.com/luminate-logistics/) provides an end-to-end platform for distribution, including transportation management/modeling, network modeling, and warehouse tasking and management.

Neubrain (https://www.neubrain.com/solutions/supplychain-logistics-analytics-software-solution) is an analytics framework with capabilities targeting earnings, sales, and distribution.

Aimms (https://www.aimms.com/aimms-for-supply-chain-professionals/) provides optimization, digital twins, and scenario analysis capabilities to model / design flows and analyze risks.

Datapine (https://www.datapine.com/logistics-analytics) offers dashboard tools and graphing, notifications, and report generation that can provide supply chain visualization and analysis.

FrieghtPOP (https://www.freightpop.com/) is a transportation management system that can be used to manage the shipping and logistics within a company.

Insight Logi Analytics (https://insightsoftware.com/logi-analytics/) uses Insight's platform for operational and production analytics, with integrated dashboards, maps, and graphs.

Oracle Supply Chain Management (SCM) (https://www.oracle.com/scm/) offers supply chain planning, inventory management, analytics, and logistics solutions.

Chainpoint (https://www.chainpoint.com/) is a cloud-based software platform to manage, share, and process supplier information and compliance. It includes TraceMap, a supply chain mapping tool to help visualize and assess suppliers.

VoxPilot Supply Chain Analytics (https://www.voxware.com/supply-chain-analytics/) presents real-time information and risk prediction for manufacturing and distribution,

collecting data from sources like sales reports, inventory records, and transportation records.

anyLogistix (https://www.anylogistix.com/) provides network design and optimization that determines the best supply chain network configuration, along with dynamic simulations.

VII. Pedagogy and Curriculum

This research guide is not written only (or particularly) for experts in the study of global supply chains. The curriculum notes we present here are intended for students interested in this topic, but also for journalists, activists, and other experts who find themselves in the beginning stages of a supply studies investigation. This section presents several areas of interest for supply studies researcher, along with a list of readings related to each area of interest. This is not intended to be a definitive list—but rather a small sample. Investigators might find pathways leading to areas that complement their research project. Instructors might choose to build courses, or develop modules in courses that draw from one or more of these areas. Students might build reading lists for specialization examinations or just their general development. Journalists might find connections to experts in areas they were not previously aware of.

Introduction to Supply Studies

Given the massive scale and complex connections that constitute global supply chains, it is difficult to know where to begin. These readings are intended as a broad introduction to supply studies and the critical study of logistics. Working from a mixture of popular and academic articles, these pieces either summarize broad arguments in the field or offer points of discussion for an initial class session centered on the contemporary discourse around logistics.

Jackie Brown, "Source Material," ***Real Life*** **(March 2021) -** Jackie Brown's article introduces readers to the field of "supply studies," explaining that this research is "rooted in the knowledge that our relationship to technology cannot be understood purely in terms of how we make use of it." Instead, supply studies is premised on "investigating the metals, refineries, factories, shipping containers, and warehouses that not only manufacture and deliver our electronics, but also form the infrastructure that organizes our society" so as to "distill and make legible these global networks, whose complexity obfuscates the harm they cause."

Michael Wilson, "Black Hole Base," ***The Journal of Aesthetics and Protest*** **(2014) -** Wilson's article introduces readers to the "Inland Empire," the region of California which has become a major shipping hub and logistics center, to argue that these places are "sacrifices for the greater goods movement industry—the global supply chain of invisible labor." Logistics, he concludes, depends on the local as much as the global, and that "the invisible labor force toils in factories overseas, but also at ports, along rail lines, and in the many warehouses used to process the flows of commodities."

Joe Allen, "Studying Logistics," ***Jacobin*** **(2015) -** Observing that the US economy revolves around a sprawling logistics industry, and that the potential power of these workers is enormous, Allen argues that Socialists should always seek out those sections of the working class that have the potential power to elevate the organization and politics of the entire class.

Charmine Chua, with Laleh Khalili and Deborah Cowen, "Logistics: Violence, Empire and Resistance," *The Dissonance of Things* (May 2016) - This discussion considers the increasing ubiquity and prominence of logistics as a mode for organizing social and spatial life, examining how this "seemingly banal concern" is foundational to contemporary global capitalism and imperialism. It concludes by asking: what might a counter-logistical project look like? What role does logistics play in anti-colonial and anti-capitalist struggles?

Miriam Posner, "The Software That Shapes Workers' Lives," *The New Yorker* (2019) - Posner explores the complexities of global supply chains, focusing on how software like SAP manages production and distribution and comparing the abstract efficiency of supply-chain management (SCM) software with the harsh realities of global supply chains.

Charles Duhigg and David Barboz, "In China, Human Costs are Built Into an iPad," iEconomy Series, *New York Times* (2012) - "Some former Apple executives say there is an unresolved tension within the company: executives want to improve conditions within factories, but that dedication falters when it conflicts with crucial supplier relationships or the fast delivery of new products…Executives at other corporations report similar internal pressures. This system may not be pretty, they argue, but a radical overhaul would slow innovation. Customers want amazing new electronics delivered every year."

Todd Frankel, "The Cobalt Pipeline," *The Washington Post* (2016) - This piece traces the cobalt pipeline and shows how cobalt mined in harsh conditions ends up in popular consumer products. Moving from small-scale Congolese mines to the batteries found inside products such as Apple's iPhones, it calls into question corporate assertions that they are capable of monitoring their supply chains for human rights abuses or child labor.

Logistical Media

Logistical media, John Durham Peters writes, are the media of "orientation," devices of cognitive, social, and political organization and control like clocks, maps, and calendars. Critical for establishing basic coordinates of time and space, they belong to "a neglected category of media that are so fundamental that they rarely come into view." These media "do not necessarily have 'content.'" Peters argues, but rather exist "prior to and form the grid"" in which messages will be sent. This "grid-like functioning" not only gestures to the foundational work of media theorists such as Harold Innis, James Carey, Lewis Mumford, and Paul Virilio, it suggests the ways this definition has been taken up scholars like Peters, Judd Case, and Ned Rossiter.

John Durham Peters, "Calendar, Clock, Tower" in *Deus in Machina: Religion, Technology, and the Things in Between* (Fordham University Press, 2012) - Peters provides an examination of the long history of human efforts to measure, divide, and coordinate space and time, demonstrating how evolving technologies for orienting people have served as both partners and competitors with religious institutions, disciplinary practices, and sources of knowledge about the cosmos. From the development of systems of calendrical reckoning for identifying religiously significant dates, and the strategic use of towers for the diverse religious purposes of celestial and terrestrial observation, to the surveillance of populations, and broadcasting of messages, Peters takes "logistical media"

to refer to the pre-discursive mechanisms and techniques used to coordinate communications and activities.

Judd Case, "Logistical Media: Fragments from Radar's Prehistory," *Canadian Journal of Communication* 38 (2013) - Case looks at the prehistory of radar—through the torpedo, the searchlight, the war horn, and the death ray—to demonstrate how logistic media order and arrange people and objects and subtly influence our experiences of space and time.

Ned Rossiter, *Software, Infrastructure, Labor: A Media Theory of Logistical Nightmares* (Routledge, 2016) - "Infrastructure makes worlds. Software coordinates labor. Logistics governs movement." Rossiter theorizes the force of logistical media to discern how subjectivity and labor, economy and society are tied to the logistical imaginary of seamless interoperability. In a computational age where media disappear into the background as infrastructure, he argues that infrastructural ruins serve as resources for the collective design of blueprints demanded for radical politics today.

Liam Cole Young, "Cultural Techniques and Logistical Media: Tuning German and Anglo-American Media Studies," *M/C Journal* 18.2 (2015) - Presenting an overview of German debates, key thinkers, texts, and concepts to English readers, this article offers a consideration of recent Anglo-American work that resonates with these debates—specifically, work by John Durham Peters and Ned Rossiter on logistical media and Jonathan Sterne on formats.

Matthew Kirschenbaum, *Bitstreams The Future of Digital Literary Heritage*, (University of Pennsylvania Press, 2021).

Paul Virilio, *War and Cinema: The Logistics of Perception* (Verso, 1989).

Jussi Parikka, *A Geology of Media* (University of Minnesota Press, 2015).

Shannon Mattern, "Middlewhere: Landscapes of Library Logistics," *Urban Omnibus* (2015).

Jordan Frith, *A Billion Little Pieces, RFID and Infrastructures of Identification* (MIT Press, 2019).

Mining and Extraction

The logistics of production's upstream end is found in the excavation of "natural" resources and the "raw" materials that lie buried in the earth. But these materials are rarely as pristine as they appear. While media studies has only recently begun to turn to the complex materiality of media technologies, the study of extractive regimes and the sites they occupy has been of longstanding interest to anthropologists and ethnographers, just as the troubled practices that occupy these operations suggest the need for deeper connections to labor history.

James Smith and Jeffrey Mantz, "Do Cellular Phones Dream of Civil War?: The Mystification of Production and the Consequences of Technology Fetishism in the Eastern Congo," in *Inclusion and Exclusion in the Global Arena* (Routledge, 2006).

Sandro Mezzadra and Brett Neilson, "Extraction, logistics, finance: Global crisis and the politics of operations," *Radical Philosophy* 178 (2013).

Matthew Hockenberry, “Inkonvensional Pathways: Soldered Supply Chains From Indonesia’s Tin Islands,” in *Objects In Motion: Globalizing Technology* (Smithsonian Press, 2016).

Ingrid Burrington, “Literal American Gold Mine,” *San Francisco Art Quarterly* (2015).

Thea Riofrancos, *Resource Radicals: From Petro-Nationalism to Post-Extractivism in Ecuador* (Duke University Press, 2020).

Samir Bhowmik, “Lithium Landscapes: From Abstract Imaginaries to Deep Time and Multi-Scalar Topologies,” *Media Fields Journal* 16 (2021).

Alex Golub, *Leviathans at the Gold Mine: Creating Indigenous and Corporate Actors in Papua New Guinea* (Duke University Press, 2014) - In this account of the relationship between an indigenous group in Papua New Guinea and the international gold mine on their land, Golub examines how the two were brought into relation to one another, and how some individuals were authorized to speak for the mine and others for the Ipili.”

Andrew Walsh, “‘Hot money’ and daring consumption in a northern Malagasy sapphire-mining town,” A*merican Ethnologist* 30 (2003) - In Ambondromifehy, a sapphire-mining town in northern Madagascar, young men earn and spend what some call “hot money.” Walsh argues that their “daring consumption" might be understood as the active response of young men who refuse the passive roles allotted them by both the sapphire trade and traditional systems of social organization.

Stuart Kirsch, *Mining Capitalism: The Relationship between Corporations and Their Critics* (University of California Press, 2014) - Mining Capitalism examines the strategies through which corporations manage relationships with critics and adversaries. Focusing on the conflict over the Ok Tedi copper and gold mine in Papua New Guinea, Kirsch reveals a slow-moving environmental disaster and the international network of indigenous peoples, advocacy groups, and lawyers attempting to protect local rivers and rain forests.

Sy Taffel, “AirPods and the earth: Digital technologies, planned obsolescence and the Capitalocene,” *Environment and Planning E: Nature and Space* (2022).

Ted Genoways, “The Price of the Paperless Revolution,” V*irginia Quarterly Review* (2010).

Tim Maughan, “The Dystopian Lake Filled by the World’s Tech Lust,” *BBC Future* (2015) - “Hidden in an unknown corner of Inner Mongolia, Maughan presents the toxic, nightmarish lake created by the thirst for smartphones, consumer gadgets and green tech.

June Nash, *We Eat the Mines and the Mines Eat Us: Dependency and Exploitation in Bolivian Tin Mines* (Columbia University Press, 1979) - This book is about the high human cost of producing tin and other minerals, as Nash describes the arduous physical labor and life of Bolivian miners in the physically inhospitable Andean mountains and reveals the contemporary social, economic, and political reality at the industrial world’s periphery.

Marina Welker, *Enacting the Corporation: An American Mining Firm in Post-Authoritarian Indonesia* (University of California Press, 2014) - Welker draws on two years of research at Newmont Mining Corporation’s Denver headquarters and its Batu Hijau copper and gold mine in Sumbawa, Indonesia, to show how people enact the mining corporation in multiple ways: as an ore producer, employer, patron, promoter of sustainable

development, religious sponsor, auditable organization, foreign imperialist, and environmental threat."

Laleh Khalili, "A World Built on Sand and Oil," *Lapham's Quarterly* (2018) - Oil and sand are not often commodities conjoined in discussions of global trade, with the first is the motive engine of industry and transportation and the latter—which makes concrete and glass and electronics possible—the second most consumed good in the world by volume after water. But for Khalili, the two commodities converge in one regard: their commodification and trade hold mirrors to global inequalities and ecological plunder.

Production and Assembly

Modern objects are networked objects. An entity like the mobile phone is not only connected, literally, within the telecommunication network. Like all global productions, it is inescapably enmeshed in the material network of its making. It is composed of cadmium, nickel, and lithium, constituted from gold, copper, tantalum, and tin. Buy to this litany of already troublesome elements, a comprehensive account must add actors, sites, and politics—both lives and ways of life. And it must contend with the ideologies of assembly that have brought them together. Consumer interest in distributed production began with outsourcing in the textile industry, but critiques of global assembly encompass everything from the hazards facing garment workers in Bangladesh to the architectures of factory cities in China.

Pun Ngai, *Made in China: Women Factory Workers in a Global Workplace* (Duke University Press, 2005) - As China has evolved into an industrial powerhouse over the past two decades, a new class of workers has developed: the dagongmei, or working girls. Made in China looks at the lives of women in their late teens and early twenties who move from rural areas to urban centers to work in factories as they are caught between the competing demands of global capitalism, the socialist state, and the patriarchal family.

Aihwa Ong, *Spirits of Resistance and Capitalist Discipline: Factory Women in Malaysia* (Suny Press, 1987) - Why are Malay women periodically seized by spirit possession on the shopfloors of factories? Ong captures the disruptions, conflicts, and ambivalences in the transition from peasant society to industrial production and how diverging roles of young men and women are channelled toward conformity with corporate culture and capitalist discipline.

Matthew Hockenberry, "Material Epistemologies of the (Mobile) Telephone," *Anthropological Quarterly* 91.2 (2018).

Sylvia Lindtner, *Prototype Nation: China and the Contested Promise of Innovation* (Princeton University Press, 2020).

Seth Perlow, "On production for digital culture: iPhone Girl, electronics assembly, and the material forms of aspiration," *Convergence* 17.3 (2011).

Minh-Ha T. Pham, "A World Without Sweatshops: Abolition Not Reform," in *Abolition Feminisms: Organizing, Survival, and Transformative Practice* (2021) - Sweatshops, Pham argues, aren't the results of individual brands behaving badly but a broad configuration of state, capital, and cultural political interests. Without a serious critique of

the sweatshop's structural reality, any efforts to make fashion more ethical is, at best, an argument for gentler and more inclusive forms of labor and resource extraction rather than the abolition of this extractive industry altogether.

Hasan Ashraf, "Beyond Building Safety: An Ethnographic Account of Health and Well-Being on the Bangladesh Garment Shop Floor," in *Unmaking the Global Sweatshop: Health and Safety of the World's Garment Workers* (University of Pennsylvania Press, 2017).

Rashedur Chowdhury, "Rana Plaza fieldwork and academic anxiety: some reflections," *Journal of Management Studies* 54.7 (2017).

Cam Simpson, "An iPhone Tester Caught in Apple's Supply Chain," *Bloomberg* (2013).

Bunnie Huang and Wired, "Shenzhen: The Silicon Valley of Hardware," *Wired* (2016);

Jenny Chan, "A Suicide Survivor: the Life of a Chinese Worker," *New Technology, Work and Employment* 28.2 (2013).

Shipping, Storage, Distribution

The most emblematic images of logistics are of storage and distribution. These are the massive warehouses stacked high with boxes, the colossal container ships that ferry them the world over, the "tens of thousands of human workers" laboring amid a gigantic system "of steel and silicon." And for good reason. The container conjures a "smooth, lossless," "almost immaterial" image of transportation, so much so that, Alexander Klose writes, it is "easily forgotten" that it was "a change in the fundamental order of thinking." For Deborah Cowen, an object like the container is thus a symbol of "logistics space," a cartography defined by the global networks of circulation. For Klose, it is a "time capsule." "Enclosed and sealed in the container," he writes, cargo is removed from the continuum in which it is produced, emerging sometime in the future.

Deborah Cowen, *The Deadly Life of Logistics: Mapping Violence in Global Trade* (University of Minnesota Press, 2014) - In this foundational project, Cowen traces the art and science of logistics from the battlefield to the boardroom and back, focusing on how the supply chain intersects with national borders, zones of piracy, blockades, and cities, she unpacks the critical role logistics has held in the making of the modern economic order.

Laleh Khalili, *Sinews of War and Trade: Shipping and Capitalism in the Arabian Peninsula* (Verso, 2021).

Dara Orenstein, Out of Stock: The Warehouse in the History of Capitalism (University of Chicago Press, 2019).

Edna Bonacich and Jake B. Wilson, *Getting the Goods: Ports, Labor, and the Logistics Revolution* (Cornell University Press, 2008) - Getting the Goods look at the ports of Los Angeles and Long Beach to examine the impact of the logistics on workers in distribution, exploring how the logistics "revolution" has enabled retailers like Walmart and Target to sell cheap consumer products made using low-wage labor in developing countries.

Pietra Rivoli, *The Travels of a T-Shirt in the Global Economy: An Economist Examines the Markets, Power and Politics of the World Trade* (Wiley, 2005) - This project traces a

T-shirt's life story from a Texas cotton field to a Chinese factory and back to a U.S. storefront before arriving at the used clothing market in Africa, uncovering the political and economic forces at work in the global economy.

Thomas Birtchnell, Satya Savitzky, John Urry, *Cargomobilities: Moving Materials in a Global Age* (Routledge, 2015).

Marc Levinson, *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger* (Princeton University Press, 2006).

Craig Martin, *Shipping Container* (Bloomsbury, 2016).

Alexis Madrigal, "Containers Series" (Fusion Media Group, 2017).

Alexander Klose, *The Container Principle: How a Box Changes the Way We Think* (MIT Press, 2015).

Jacob Hodes, "Whitewood under Siege," *Cabinet* 53 (2013/14).

Beth Kowitt, "It's Ikea's world. We just live in it," *Fortune* (2015) - This article examines "the magic of flat packing," the mechanism that allows goods to be jammed into shipping containers without wasting any space.

Jesse LeCavalier, *The Rule of Logistics: Walmart and the Architecture of Fulfillment* (Minnesota Press, 2016).

Daniel Banoub and Sarah J Martin, "Storing value: The infrastructural ecologies of commodity storage," *Environment and Planning D: Society and Space* 38.6 (2020).

Nicky Gregson, Mike Crang, and Constantinos N. Antonopoulos, "Holding together logistical worlds: Friction, seams and circulation in the emerging 'global warehouse,'" *Society and Space* (2017).

Moira Weigel, "Inside the Whale: An Interview with an Anonymous Amazonian," *Logic* (2020).

Alessandro Delfanti, *The Warehouse: Workers and Robots at Amazon* (Pluto Press, 2021).

Speculations on Supply

Supply chains are not new, Anna Tsing reminds us, they reach back as far as trade itself. But what is new is the "sense of possibility that supply chains offer." Founded on "the enhanced mobility of labor and the economic and political vulnerabilities created by recent forms of imperialism and histories of global war," production was no longer composed of silo-ed sites of assembly. It was a "networked enterprise," tightly coupling suppliers and distributors to maximize the efficiency of the productive process. With associations formed by arrangements of subcontracting, outsourcing, and an overriding logic of flexibility and interchange, "supply chain capitalism" has produced new possibilities for exploitation and defined new subjectivities for those within its web. So too, it demands correspondingly new ways of thinking to unravel them. To that end, this section engages with the critiques and critical theories that engage with the supply chain, logistics, and the global system of circulation.

Anna Tsing, “Supply Chains and the Human Condition,” Rethinking Marxism: A Journal of Economics, Culture and Society 21.2 (2009).

Alberto Toscano, “Lineaments of the Logistical State,” *Viewpoint Magazine* 4 (2014) - Toscano argues that “the apparatuses of control and accumulation that structure the social and material reality of circulation,” namely transport, the energy industry, and business logistics, “though born to break the bargaining power of transport workers” have instead “created dynamic arenas for class struggle.”

Deborah Cowen, “Disrupting Distribution: Subversion, the Social Factory, and the ‘State’ of Supply Chains,” *Viewpoint Magazine* 4 (2014) - Cowen argues that “we have entered a time of logistics space,” writing that “contemporary capitalism is organized as a dispersed but coordinated system, where commodities are manufactured across vast distances, multiple national borders, and complex social and technological infrastructures.” Here, geopolitical economies that were previously governed at a national scale have instead been “reordered into transnational circulatory systems.”

Sergio Bologna, “Inside Logistics: Organization, Work, Distinctions,” *Viewpoint Magazine* 4 (2014) - "Logistics” Bologna writes, “can never be understood from outside the warehouse.” It is “only by coming inside and looking at the techniques employed, the equipment and the organization of work” that we can differentiate between the gradations of logistical order.

Chandra Mukerji, “The Territorial State as a Figured World of Power: Strategics, Logistics, and Impersonal Rule,” *Sociological Theory* 28:4 (2010).

Sandro Mezzadra and Brett Neilson, *Border as Method, or, the Multiplication of Labor* (Duke University Press, 2013).

Martin Danyluk et al., “Capital’s logistical fix: Accumulation, globalization, and the survival of capitalism” in “Turbulent Circulation: Building a Critical Engagement with Logistics,” Society and Space 36.4 (2018) - In this introductory essay, the authors “take stock of the ascendancy and proliferation of logistics,” arguing that logistics is best understood as a calculative logic and spatial practice of circulation that is at the fore of the reorganization of capitalism and war.

Jasper Bernes, “Logistics, Counterlogistics, and the Communist Propspect,” *Endnotes* 3 (2013).

Niccolò Cuppini, Irene Peano, Evelina Gambino, Maurilio Pirone, Carlotta Benvegnú, Mattia Frapporti, “Gendering Logistics: Feminist Approaches for the Analysis of Supply Chain Capitalism,” *Into the Black Box* (2021).

Jussi Parikka, “A Natural History of Logistics,” Strelka (2020).

Benjamin McKean, “What Supply Chains Teach Us About Neoliberalism,” *LPE Project* (2021).

Stefano Harney and Fred Moten, *The Undercommons: Fugitive Planning and Black Study* (Autonomedia, 2013) - In this series of essays Moten and Harney draw on the theory and practice of the black radical tradition as it “supports, inspires, and extends contemporary social and political thought and aesthetic critique.” To this end, Moten and

Harney develop and expand an array of concepts: study, debt, surround, planning, and the shipped.

Activism and Resistance

As a site of resistance against global capital, the supply chain shares none of the power present in the gatherings once found on the planation or the factory floor. As Charmaine Chua explains, sites like the port have all but been "evacuated of the workers" they once "depended so heavily upon." Supply chain management has shifted capital's focus from the sites of production to those of circulation, and as a consequence, "the mass labor force expelled from the factory floors of the world has now spilled into the streets, articulating their dissatisfaction with the state of things through uprisings, strikes, blockades, and riots." Has this "foreclosed collective action"? If not—if the supply chain may yet be thought of "as a scattered entity" with which one may still engage—then what are its points of vulnerability, the most effective means of resistance?

Jake Alimahomed-Wilson and Immanuel Ness, *Choke Points: Logistics Workers Disrupting the Global Supply Chain* (Chicago University Press, 2018) - As it explores a number of case studies around the world, this book reveals a network of resistance by logistics workers worldwide who are determined to contest their exploitation by the forces of global capital. Through "close accounts of wildcat strikes, roadblocks, and boycotts, from South China to Southern California, the contributors build a picture of a movement that flies under the radar, but carries the potential to force dramatic change."

Charmaine Chua, "Logistics, Capitalist Circulation, Chokepoints," *The Disorder of Things* (2014).

"Disaster Communism III: Logistics, Repurposing, Bricolage," *Libcom* (2014).

"Choke Points: Mapping an Anticapitalist Counter-logistics in California," *Libcom* (2014).

Seattle N30 Logistical Crew, "Seattle Logistics Zine" (1999).

Alberto Toscano. "Logistics and Opposition," *Mute* (2011).

Brian Ashton, "Logistics Explained," *Labournet* (2007).

Niccolò Cuppini, Mattia Frapporti, Floriano Milesi, Luca Padova, Maurilio Pirone, "Logistics and Crisis: The Supply Chain System in the Po Valley Region," *Teaching the Crisis – Geographies, Methodologies, Perspectives* (2013).

Laleh Khalili, "The Logistics of Counterinsurgency," Center for Contemporary Arab Studies (2006).

Edna Bonacich, "Labor and the global logistics revolution," in *Critical Globalization Studies* (Routledge, 2005), 359–368.

Katie Mazer and Martin Danyluk, "Mapping a Many Headed Hydra: The Struggle Over the Dakota Access Pipeline," *Infrastructure Otherwise Report* 001 (2017).

Iris Young, "From Guilt to Solidarity: Sweatshops and Political Responsibility," Dissent 50.2 (2003).

Sonja Mönkedieck, “The iPhone 4CF (Conflict Free): The Yes Men Address the Conflict in the Democratic Republic of the Congo,” Liminalities 7.4 (2011).

Kathryn Babineau and Jennifer Bair, “The Art of Using Supply Chains to Defend Worker Rights” Open Democracy (2020).

Gabriel Grill, “Future Protest Made Risky: Examining Social Media Based Civil Unrest Prediction Research and Products,” *CSCW* 30 (2021).

Logistical Histories

The supply chain has a hard origin point in history—when business consultant Keith Oliver proposed, in a meeting with the Dutch consumer electronics manufacturer Philips, the idea of managing production, marketing, distribution, sales, and finance “as though” they were a single entity. He called the approach, “supply chain management.” But logistical operation has a far more ancient lineage than this. Since the beginning of time humans have exchanged goods, moved materials, and distributed the work of production. Historical accounts that are relevant to the study of logistics include its recognition in the art of war and its adoption by businesses for the optimization of transportation and manufacture, but they also include broader histories of commodity exchange, labor, and nature.

Sven Beckert, *Empire of Cotton: A Global History* (Knopf, 2014) - Cotton is so ubiquitous as to be almost invisible, but Beckert tells the story of how, in a remarkably brief period, European entrepreneurs and statesmen recast the world’s most significant manufacturing industry, combining imperial expansion and slave labor with new machines and wage workers to usher in the era of modern capitalism.

Sidney Mintz, Sweetness and Power: The Place of Sugar and Modernity (Viking, 1985) - While Mintz observed that “studying a single food or commodity such as sugar may seem like an incongruous project for an anthropologist who claims to work mostly with living people,” as the popularity of sugar “rose together with tea, colonial slavery, and the machine era” its history offered an almost unparalleled look into the history and character of the modern world.

Deborah Cowen, “A Geography of Logistics: Market Authority and the Security of Supply Chains,” *Annals of the Association of American Geographers* 100.3 (2010).

Deborah Cowen, “Logistics’ Liabilities,” *LIMN* 1 (June 2011).

James A. Huston, *The Sinews of War: Army Logistics, 1775-1953* (Center of Military History, United States Army, 1997).

Martin van Creveld, *Supplying War: Logistics from Wallenstein to Patton* (Cambridge University Press, 1977).

John A. Lynn, *Feeding Mars: Logistics In Western Warfare From The Middle Ages To The Present* (Westview Press, 1994).

Manuel De Landa, *War in the Age of Intelligent Machines* (Zone Books, 1991).

Patrick Chung, “From Korea to Vietnam: Local Labor, Multinational Capital, and the Evolution of US Military Logistics, 1950–97,” *Radical History Review* 133 (2019).

Wesley Attewell, “Just-in-Time Imperialism: The Logistics Revolution and the Vietnam War,” *Annals of the American Association of Geographers* 111.5 (2020).

Martin T. Farris, “Evolution of Academic Concerns with Transportation and Logistics,” *Transportation Journal* 37.1 (1997).

M.L. Emiliani, “Historical Lessons in Purchasing and Supplier Relationship Management,” *Journal of Management History* 16.1, (2010).

Paul L. Govekar and Michele A. Govekar, “The Parable of the Pig Iron: Using Taylor’s Story to Teach the Principles of Scientific Management,” *Journal of Higher Education Theory and Practice* 12.2 (2012).

Corporations and Capitalism

While critiques of the corporation reach back to the birth of capitalism, one of the first critiques of the supply chain came when protesters targeted Dow Chemical’s manufacture of napalm. The conclusion—that corporations should be responsible for what they produce—served to negotiate the relationship between publics and products. As corporations became increasingly complex, however, this connection was no longer so clear. When evidence was found in 1996 of child labor in textile outsourcing, the public outcry that resulted from Nike’s infamous “sweatshop summer” signaled a renegotiation of corporate responsibility. Companies were now to be held accountable for the whole of their supply chain.

Pietra Rivoli and Sandra Waddock, “‘First They Ignore You…’: The Time-Context Dynamic and Corporate Responsibility,” California Management Review 53.2 (2011) - In this piece, Rivoli and Waddock explore the discourse around corporate social responsibility, arguing that it is ultimately either irrelevant—because activities are already profitable—or ineffective—because their is little motivation and few consequences.

Raluca Dragusanu, Daniele Giovannucci, and Nathan Nunn, “The Economics of Fair Trade,” *Journal of Economic Perspectives* 28.3 (2014).

Damani James Partridge, “Activist Capitalism and Supply-Chain Citizenship: Producing Ethical Regimes and Ready-to-Wear Clothes,” *Current Anthropology* 52.S3, (2011).

Kim Fortun, *Advocacy after Bhopal: Environmentalism, Disaster, New Global Orders* (University Of Chicago Press, 2001).

Susan Schultz Huxman and Denice Beatty Bruce, “Toward a dynamic generic framework of apologia: A case study of Dow chemical, Vietnam, and the napalm controversy,” *Communication Studies* 46.1-2 (1995).

Richard Locke, Fei Qin, and Alberto Brause, “Does Monitoring Improve Labor Standards? Lessons from Nike,” Corporate Social Responsibility Initiative, Working Paper 24 (John F. Kennedy School of Government, Harvard University, 2006).

Dara O'Rourke, "Smoke From a Hired Gun: A Critique of Nike's Labor and Environmental Auditing in Vietnam as performed by Ernst and Young," CorpWatch (1997).

Simon Bøge "The Well-travelled Yoghurt pot: Lessons for new Freight Transport Policies and Regional Production," World Transport Policy & Practice 1, no. 1 (1995): 7-11.

Stephen John New, "Modern Slavery and the Supply Chain: the Limits of Corporate Social Responsibility?" *Supply Chain Management* 20.6 (2015).

Computational Production

Software, Ben Bratton writes, is a "part of every supply chain." And indeed, it is impossible to speak of global logistics without considering the logistical software systems that govern it. Companies like SAP design integrated solutions that not only manage the whole of the supply chain, they constitute it. If production and digitization have become nearly synonymous, what difference is the container from the cloud?

Benjamin Bratton, *The Stack: On Software and Sovereignty* (MIT Press, 2015).

Tung-Hui Hu, *A Prehistory of the Cloud* (MIT Press, 2015).

Moritz Altenried, "The Container and the Algorithm: Logistics in Global Capitalism," *Période* (2019)

Jean-Christophe Plantin, "The Data Archive as Factory: Alienation and Resistance of Data Processors," *Big Data and Society* (2021).

Miriam Posner, "Breakpoints and Black Boxes: Information in Global Supply Chains," *Postmodern Culture* 31.3 (2021) - Posner examines how data works in global supply chains, focusing on SAP SCM and arguing that SCM is characterized by two countervailing tendencies: "the demand for perfect information about goods and movement, and the need to erect strategic barriers to the fullest knowledge about supply chains."

Vincent A. Mabert, "The Early Road to Material Requirements Planning," *Journal of Operations Management* 25 (2007).

Mohammad A. Rashid, Liaquat Hossain, and Jon David Patrick, "The Evolution of ERP Systems: A Historical Perspective" in *Enterprise Resource Planning: Global Opportunities and Challenges* (Idea Group, 2002).

Anne Pasek and Nicole Starosielski, "Fiber, Fingers, and Code: Manufacturing Software and Seamlessness in the Garment Industry," *Television and New Media* 22.5 (2021).

Zane Griffin Talley Cooper, "Of dog Kennels, Magnets, and Hard Drives: Dealing With big Data Peripheries," *Big Data and Society* (2021).

Patrick Brodie, "Climate Extraction and Supply Chains of Data," *Media Culture and Society* 42.7–8 (2020).

Moritz Altenreid, *The Digital Factory: The Human Labor of Automation* (Chicago University Press, 2022).

Filipe Calvão and Matthew Archer, “Digital Extraction: Blockchain Traceability in Mineral Supply Chains,” *Political Geography* 87 (2021).

Catie Keck, “A Look Under the Hood of the Most Successful Streaming Service on the Planet *The Verge* (2021).

Infrastructures and Spaces

Geography, Clare Lyster writes, “is no longer a prerequisite for urbanism; the network is. At the same time that logistics denies place, however, it would be misleading to say that it is completely a-geographic.” Rather, it only “upends the city’s traditional reliance on geophysical qualities to facilitate new possibilities…”

Clare Lyster, *Learning from Logistics: How Networks Change Our Cities* (Walter de Gruyter, 2016) - “In the 19th century,” Lyster argues, “railroads and canals provided both structure and motor for city development.” Today this role has been taken over today by the global flow of data and products, and, as a result, logistics networks and their complex structure increasingly bear upon many urban spheres.

Keller Easterling, Jesse LeCavalier, and Clare Lyster, “Logistics, Flow, and Contemporary Urbanism,” *Cabinet* (2016).

Shannon Mattern, “Infrastructural Tourism,” *Places Journal* (2013).

Lisa Parks and Nicole Starosielski, *Signal Traffic: Critical Studies of Media Infrastructures* (University of Illinois Press, 2015).

Brett Neilson and Ned Rossiter, “The Logistical City,” in *Transit Labour: Circuits, Regions, Borders* 3 (2011)

Dara Orenstein, “Foreign-Trade Zones and the Cultural Logic of Frictionless Production,” *Radical History Review* 109 (2011).

Rozalinda Borcila, “Riding the Zone,” in *Deep Routes: The Midwest in all Directions* (2015).

Ingrid Burrington, “The Cloud is Not the Territory,” *Waging Nonviolence* (2014).

Brian Larkin, “The Politics and Poetics of Infrastructure,” *Annual Review of Anthropology* 42 (2013).

Susan Leigh Star, “The Ethnography of Infrastructure,” *American Behavioral Scientist* 43.3 (1999).

Markus Hesse, *The City as a Terminal: The Urban Context of Logistics and Freight Transport* (Routledge, 2016).

Shannon Mattern, *Code and Clay, Data and Dirt, Five Thousand Years of Urban Media* (University of Minnesota Press, 2017).

Hong Shen, *Alibaba: Infrastructuring Global China* (Routledge, 2022).

David Vega-Barachowitz and Adam Luubinsky, “Ship Shape,” *Urban Omnbius* (2020).

Mark Graham and Martin Dittus, *Geographies of Digital Exclusion* (Pluto Press, 2022).

Mél Hogan and Asta Vonderau, “The Nature of Data Centers,” *Culture Machine* 18 (2021).

Sayd Randle, “Holding Water for the City: Emergent Geographies of Storage and the Urbanization of Nature,” *Environment Planning E: Nature and Space* (2021).

Consumers and Consumption

“In the new predominance of an organized market,” Raymond Williams wrote, “the acts of making and of using goods and services were newly defined in the increasingly abstract pairings of producer and consumer, production and consumption.” The term, once meant in “an unfavorable sense”—”to destroy, to use up, to waste, to exhaust,” has become the identity through which the supply chain is approached—an abstract relationship from which to view an abstraction.

Brett Neilson, “Beyond Kulturkritik: Along the Supply Chain of Contemporary Capitalism”, *Culture Unbound* 6 (2014): 77–93.

Dara O’Rourke, *Shopping for Good* (MIT Press, 2012).

Roopali Mukherjee, “Diamonds (are from Sierra Leone): Bling and the Promises of Consumer Citizenship,” in Commodity Activism: Cultural Resistance in Neoliberal Times (New York University Press, 2012)..

Altha Cravey, “Students and the Anti-Sweatshop Movement,” *Antipode* 36 (2004).

Abigail Bakan and Yasmeen Abu-Laban, “Palestinian Resistance and International Solidarity: the BDS Campaign,” *Race and Class* 51.1 (2009).

Clive Barnett, Paul Cloke, Nick Clarke, Alice Malpass, “Consuming Ethics: Articulating the Subjects and Spaces of Ethical Consumption,” *Antipode* 37.1 (2005).

Iris Young, “Responsibility and Global Labour Justice,” *The Journal of Political Philosophy* 12.4 (2004).

Stephen Duncombe, “It stands on its head: Commodity fetishism, consumer activism, and the strategic use of fantasy,” *Culture & Organization* 18.5 (2012).

Veronica Redini, “Commodity Fetishism Again. Labour, Subjectivity and Commodities in ‘Supply Chains Capitalism,’” *Open Cultural Studies* 2.1 (2018).

David Boarder Giles, *A Mass Conspiracy to Feed People* (Duke University Press, 2021).

Aaron Shapiro, “Platform Urbanism in a Pandemic: Dark Stores, Ghost Kitchens, and the Logistical-urban Frontier,” *Journal of Consumer Culture* (2022).

Joseph Turow, *The Aisles Have Eyes: How Retailers Track Your Shopping, Strip Your Privacy, and Define Your Power* (Yale University Press, 2017).

Nicola Twilley, “What Do Chinese Dumplings Have to Do With Global Warming?” *New York Times* (2014) - Twilley examines “the critical growth area is what’s known in the logistics business as the “cold chain”—the seamless network of temperature-controlled space through which perishable food is supposed to travel on its way from farm to refrigerator.

Dan Williams, "Christmas in Yiwu" (2014) - "It was the 1st of August, 27°C outside and All I Want For Christmas was drifting out of a market stall dedicated to selling Santa hats," Dan Williams writes, with neighboring booths filled with artificial Christmas trees, baubles and Christmas stockings. "More than half of the world's Christmas decorations come from here."

Amanda Mull, "The Nasty Logistics of Returning Your Too-Small Pants: What happens to the stuff you order online after you send it back? *The Atlantic* (2021).

Tamara Kneese, "Keep it Oakland: E-commerce Meets Social Justice," *Media, Culture, and Society* (2021).

Lara Houston, "The Timeliness of Repair," *Continent* 6.1 (2017).

Jason Farman, "Repair and Software: Updates, Obsolescence, and Mobile Culture's Operating Systems," *Continent* 6.1 (2017).

Lisa Parks, "Media Fixes: Thoughts on Repair Cultures," *Flow Journal* (2013).

Rowan Moore Gerety, "Downstream: The Afterlife of American Junk," *Harper's Magazine* (2019).

Sarah T. Roberts, "Digital Refuse: Canadian Garbage, Commercial Content Moderation and the Global Circulation of Social Media's Waste," *Wi: Journal of Mobile Media* 10.1 (2016).

Short Topics

This section describes shorter, more supplemental topics that can be incorporated into the primary areas already presented.

Supply Chains in the (Post) Pandemic
Additional readings that examine the impact of the COVID-19 pandemic on global supply.

Kim Moody, "The Supply Chain Disruption Arrives 'Just in Time,'" *Labor Notes* (2021).

Ingrid Burrington, "After Supply Chain Capitalism: We Need A Social Net That Protects All People," *Data & Society: Points* (2020).

Sarah T. Roberts, "Over*Flow: Digital Humanity: Social Media Content Moderation and the Global Tech Workforce in the Covid-19 Era," *Flow Journal* (2020).

Modes of Production
Reflections on the productive systems central to supply chain capitalism.

Kim Moody, "The Rise and Limits of Lean Production," in *Workers in a Lean World* (Verso, 1997).

Bruce Allen, "The Logistics Revolution and Transportation," *The Annals of the American Academy of Political and Social Science* 553 (1997).

Brian Holmes, “Do Containers Dream of Electric People: The Social Form of Just-in-time Production,” *Open* 21 (2011).

Beth Gutelius, “Disarticulating distribution: Labor segmentation and subcontracting in global logistics,” *Geoforum* 60 (2015).

Brian Ashton, “The Factory Without Walls,” *Mute* (2006).

Marc Steinberg, “From Automobile Capitalism to Platform Capitalism: Toyotism as a Prehistory of Digital Platforms,” *Organization Studies* (2021).

Migration and Mobility
Readings considering the complex relationship between logistics, power, and mobility.

Craig Martin, “Desperate Mobilities: Logistics, Security and the Extra-Logistical Knowledge of ‘Appropriation.’” *Geopolitics* 17.2 (2012).

Gargi Bhattacharyya, *Traffick: The Illicit Movement of People and Things* (Pluto Press 2005).

Anja Kanngieser, “Tracking and Tracing: Geographies of Logistical Governance and Labouring Bodies,” *Environment and Planning D: Society and Space* 31.4 (2013).

Lorenzo Vianelli, “Warehousing Asylum Seekers: The Logistification of Reception,” *Environment and Planning D: Society and Space* 40.1 (2022).

Rutvica Andrijasevic & Tonia Novitz, “Supply Chains and Unfree Labor: Regulatory Failure in the Case of Samsung Electronics in Slovakia,” *Journal of Human Trafficking* 6.2 (2020).

Rafeef Ziadah, “Circulating Power: Humanitarian Logistics, Militarism, and the United Arab Emirates,” *Antipode* 51.5 (2019).

Elisa Pascucci, “Refugee Shelter in a Logistical World: Designing Goods for Supply-Chain Humanitarianism,” *Antipode* 53.1 (2021).

Deviant Circulation
Examinations of illicit circulations, especially those enabled by decentralized digital technology.

Nils Gilman, Steven Weber, and Jesse Goldhammer, *Deviant Globalization* (Continuum, 2011).

Nicolas Maigret and Maria Roszkowska, *The Pirate Book* (Aksioma, 2015).

Digital Citizens Alliance, “Busted, But Not Broken: The State of Silk Road and the Darknet Marketplaces” (2014).

Nicolas Christin, “Traveling the Silk Road: A measurement analysis of a large anonymous online marketplace,” CyLab Technical Report, Carnegie Mellon University (2012).

Andy Greenberg, “Waiting for Dark: Inside Two Anarchists’ Quest for Untraceable Money,” *Wired* (2014).

Luca Rastello, *I Am the Market: How to Smuggle Cocaine by the Ton, in Five Easy Lessons* (Granta, 2010).

Elliot Anderson, "It's a Pirate's Life for Some: The Development of an Illegal Industry in Response to an Unjust Global Power Dynamic," *Indiana Journal of Global Legal Studies* 17.2 (2010).

Primary Sources

A selection of significant historical readings for modern business logistics.

Peter Drucker, "The Economy's Dark Continent," *Fortune* (1962).

Tim Laseter and Keith Oliver, "When Will Supply Chain Management Grow Up?" *Strategy and Business* 32 (2003).

Arnold Kransdorff, "High stock levels—not the answer to volatile demand, Arnold Kransdorff reports on 'supply chain management,'" *Financial Times* (1982).

Edward W. Smykay and Bernard J. LaLonde, *Physical Distribution Management* (The Macmillan Company, 1968).

Bernard J. LaLonde, John R. Grabner, and James F. Robeson, "Integrated Distribution Management: A Management Perspective," *The International Journal of Physical Distribution* 44.1 (1970).

Raymond Lekashman and John F. Stolle, "The Total Cost Approach to Distribution," *Business Horizons* 8.4 (1965).

Other Guides and Resources

Exposing the Invisible: The KIT - Supply Chain and Product Investigations provides an introduction to supply chain investigations including an overview of tools, techniques, data resources, and precautions. It focuses on the main actors, stages and processes of a supply chain and includes a hypothetical step-by-step investigation (https://kit.exposingtheinvisible.org/en/supply-chain.html).

The Global Investigative Journalism Network (GIJN) Supply Chain Resource Page includes a general introduction to (journalistic) supply chain resource, and a collected list of research tools, reports, and resources. It also includes special areas of interest on Maritime Shipping, Human Trafficking and Slavery, Extractive Industries, and Corruption (https://gijn.org/resource/investigating-supply-chains/).

The Investigating Illegal Timber Guidebook provides instructions on investigating illegal timber supply chains, including detailed guidance on the sources of information and tools that can be used to find out if timber is being illegal harvested, traded and sold to sensitive markets (https://www.earthsight.org.uk/tic/guidebook).

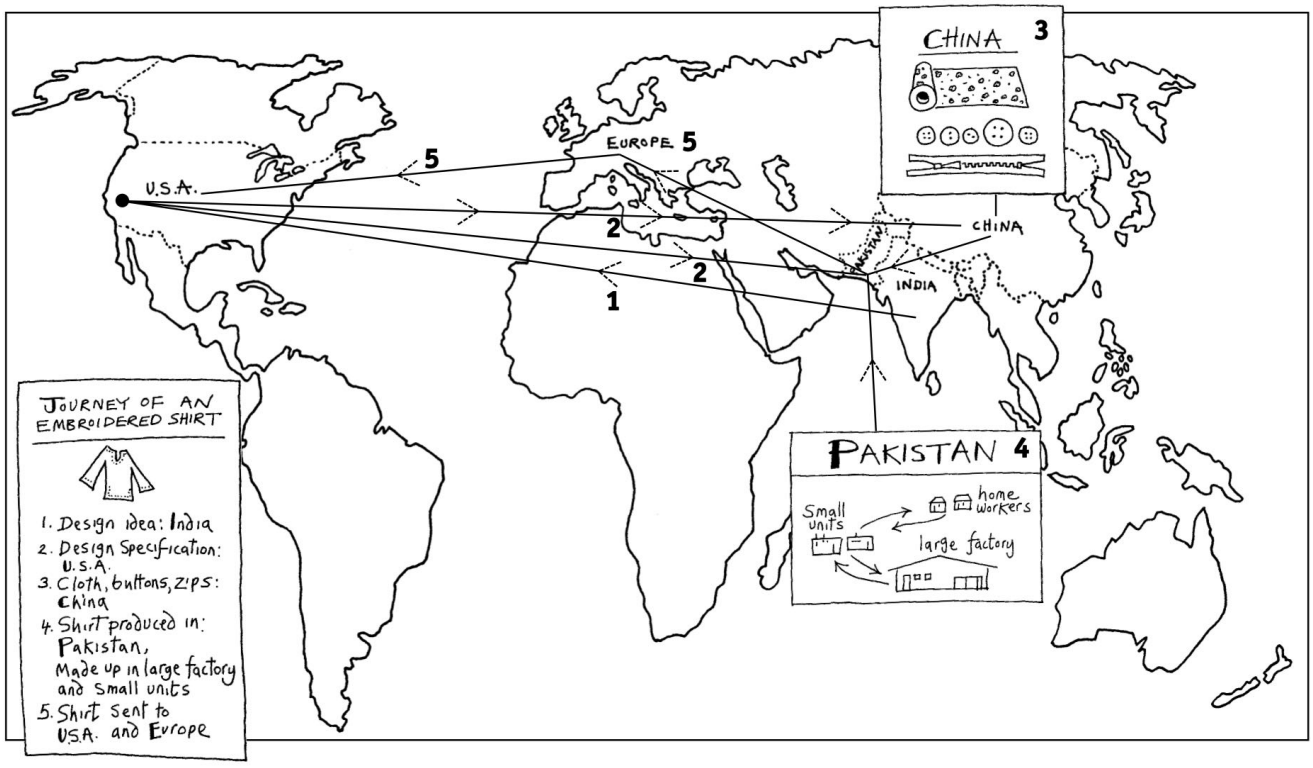
Rutgers "Researching Supply Chains" Library guide collects a large list of links to databases, search tools, and other library resources that may be useful in studying supply chains (https://libguides.rutgers.edu/supply_chain).

Garment Supply Chain Education Pack focuses on supply chains in the garment industry, with the aim to assist garment workers in understanding the supply chains in which they are working, helping them to maximize their opportunities to organize and build solidarity.

Activities

Every supply chain investigation is different. We have already described the diverse array of methods that one might use to investigate logistical operations. These are a collection of activities intended for classes in the critical study of logistics (in their entirety or as a module within a larger course), workshops, or for individuals coming to supply studies from other fields.

Rough Mapping: This activity requires participants to produce a rough map of the supply chain, collaboratively or in groups. The goal is not to produce a definitive presentation of the "real" supply chain, but to use the map as a brainstorming mechanism for collecting all of the possible geographies implicated by a particular products production and distribution. This activity can be conducted before any research has been undertaken, or (alternatively) it can be performed after an initial pre-research process.



Mapping an Embroidered Shirt (from the Garment Supply Chain Education Pack).

Supply Interview: Conduct a short (15 minute) interview with someone involved in the production, design, distribution, or repair of an object, delivering an annotated transcript of

the interview. The goal of this activity is to learn how to identify people involved in various aspects of an object's supply chain, how to approach them, and how to conduct an effective interview. Questions should be brainstormed in advance of the interview based on pre-research about the object's supply chain, but the interviewer should be responsive to the direction of the conversation and be prepared to followup on points raised during the interview. After the interview has been completed, the interviewer should go over the transcript and identify points they would like to follow up on, either in subsequent interviews or through other research, including particular phrases, terminology, or technical concepts. The interviewer should also produce a brief summary of the key points of the discussion.

Assembly Analysis: An assembly analysis looks at the parts—the components, subcomponents, materials, etc.— that constitute a particular object. Analysts should identify all of these components, either by conducting a product autopsy or by reviewing bills of material and production diagrams. The analyst will then make a list of all of the components, including information like the manufacturing company, site of manufacture, part function, part number, part prices, part uses, and so on. In addition to this data, the analyst will produce an "explosion diagram" of the product illustrating all of these components. The goal of this activity is to begin to understand the material constitution of the product. Ideally some information on suppliers and potential manufacturing sites might be uncovered, but it is more important to identify the parts and their function in the overall assembly of the product.

Product Autopsy: A product autopsy, what is sometimes called a "tear down," may be conducted in concert with an assembly analysis or as a separate activity. In a product autopsy, the investigator disassembles a product as best they can into its component parts. Depending on the technical skill of the investigator, this can be a risky procedure, so it can sometimes be useful to use a broken or nonfunctional unit. Once the object is disassembled, detailed inspection of the components may be conducted. In electronic devices, for example, many components may feature identifiers like manufacturer name or part number, and this information may also be included in bar codes or qr codes printed or attached to the components. Depending on the nature of the investigation, detailed measurements (size, weight, etc.) can also be conducted. In some special cases (where students are already in a laboratory environment) laboratory analysis may be used to determine chemical composition and other details not available to the naked eye.

Application Autopsy: The application autopsy is the digital equivalent of a product autopsy, investigating the supply chain of a digital product, like a website or digital video. Users performing an application autopsy may use tools like web development features of browsers or tracker plugins to determine what libraries are used in an application. Information like IP addresses of sites, content delivery networks, and so on may be collected and mapped to third-party services and geographic areas. Public information on domain registration may be consulted, and so on. For non-web applications, code analysis may be conducted or network analysis tools may be used to identify external resources accessed by an application. In some cases, such as for video or images, metadata tools can be used to access embedded details in individual files.

Consumption Ethnography: A consumption ethnography looks at the sites of the supply chain which are generally the most accessible: retail stores and marketplaces. In a consumption ethnography, investigators spend time on one or two retail spaces, documenting

their observable operations, interviewing employees and potential customers, and otherwise mapping out the function and feel of the space. The output is generally a short report and photographic essay on the site(s).

Distribution Diagram: The distribution diagram looks at sites of production or distribution (generally places like factories, warehouses, ports, and the like), and attempts to understand how materials flow through these sites. The approach to this diagram varies considerably depending on the kind of access an investigator has. Investigators with significant access, reliable informants, or detailed records might be able to reproduce annotated floor plans of a facility. Others might be more akin to flow diagrams, with abstract representations of functional units and spaces within a site.

Critical Logistics Community

Special Issues on Logistics

> Charmaine Chua, Martin Danyluk, Deborah Cowen, Laleh Khalili, "Turbulent Circulation: Building a Critical Engagement with Logistics," *Society and Space* 36.4 (August 2018).
>
> *Cabinet* 47: Logistics (Fall 2012).
>
> "Logistics of Power" in *Viewpoint Magazine* 4 ("The State") (September-October 2014).
>
> Patrick Brodie, Lisa Han, Weixian Pan, "Becoming Environmental: Media, Logistics, and Ecological Change," *Synoptique* 8.1 (2019)
>
> "Supply," *Thresholds* 49 (2021).
>
> "Logout! Worker Restance Within and Against the Platform Economy," *Notes From Below* 7 (June 2019).
>
> Matthew Hockenberry and Miriam Posner, "Logistical Histories of Computing," *IEEE Annals of the History of Computing* 46 (April-June 2024)

Conferences and Workshops

> "Supply and Command: Encoding Logistics, Labor, and the Mediation of Making," New York University (April 19th-20th, 2018).
>
> "Cold Logics, Cold Logistics," Benjamin Noys, Accelerationism and Aesthetics Seminar, Konstfack CuratorLab (2016).
>
> "Turbulent Circulation / Toward a Critical Logistics," University of Toronto (October 9-11, 2015).
>
> "The Arts of Logistics," Queen Mary University of London (June 3-4, 2016).
>
> "Unpacking Organization. Cybernetics, Logistics, and the Labour of Circulation," Centre for Digital Cultures (CDC), Leuphana University of Lüneburg (June 19, 2016)

"Logistics of soft control: SAP, labour, organization," Leuphana University, Lüneburg (June 20-21, 2013).

"Logistical Nightmares," The Centre for Research Architecture, Goldsmiths, University of London / Sonic Arts (2017-2018).

"In/Convenience Seminar," GEMLab (2021).

"The Terraforming," Strelka (2022).

Courses, Syllabi, and Reading Lists

"The Global Social Factory and Supply Chains," The Public School (2012), https://web.archive.org/web/20160812023542/http://thepublicschool.org/node/31602.

"Logistical Nightmares," and "Futureland," The Centre for Research Architecture, Goldsmiths, University of London / Sonic Arts (2017-2018), https://logisticalnightmaressite.wordpress.com/readings/ and https://logisticalnightmaressite.wordpress.com/wp-content/uploads/2018/08/futureland-reader1.pdf.

Charmaine Chua, "Reading Guide for Logistics", Période (in French; 2019), http://revueperiode.net/la-logistique/.

followthethings Reading Lists (2017-2019), https://followtheblog.org/reading-lists/.

Alice Marwick, "Networked Societies" (Amazon Focused; Spring 2019), https://tiara.org/2019/01/08/neworked-societies-first-year-seminar/

Jesse LeCavalier, "Landscapes of Fulfillment" (2018), https://landscapes-of-fulfillment.org/.

Grant Wythoff, "Introduction to Digital Media" (2017) (with supply chain project: https://gwijthoff.github.io/digitalmedia/final.html).

Projects and Groups

Logistical Worlds (https://logisticalworlds.org/) examines how to study China-led globalization through infrastructural interventions, tracking algorithmic arrangements of power across the tri-continental sites of Piraeus, Valparaíso and Kolkata.

Empire Logistics (https://www.empirelogistics.org/) is an interactive mapping project begun in 2009 which maps the global supply chain through by articulating the infrastructure and externalized costs—human, economic, social, and environmental—of the international flow of things.

Center for Land Use Interpretation (https://clui.org/) is a research and education organization interested in understanding the nature and extent of human interaction with the surface of the earth, and in "finding new meanings in the intentional and incidental forms that we individually and collectively create."

Transit Labour (https://transitlabour.asia/) investigates changing patterns of labour and mobility in Asian capitalist transformation. This three year research project examines the role

of creativity, invention and knowledge production in the new economic order being forged from the region's capitalist centers.

followthethings (http://www.followthethings.com/) is a website designed to have the look, feel and navigation of a familiar online store, but it's stocked with research examining films, art, activist and other work that encourages shoppers to critically consider their relationships with those who make the things that they buy. Its purpose is to "encourage careful thought and lively conversation about trade (in)justice, and to encourage and inform new work in this genre of commodity activism."

The Story of Stuff Project (https://www.storyofstuff.org/) argues that "we have a problem with Stuff—We use too much, too much of it is toxic and we don't share it very well." The project encourages civic and community action to prompt environmental and social change around material consumption.

Unknown Fields Division (https://www.unknownfieldsdivision.com/mission.html) is a design research studio that bears witness to "alternative worlds, alien landscapes, industrial ecologies and precarious wilderness," using film and animation to chronicle this network of hidden stories and re-imagine the realities of the present.

The Infrastructure Observatory (https://infraobservatory.com/) is a community devoted to exploring and celebrating the infrastructural landscape, with a mission to render visible the "oft-invisible guts of modern life."

Warehouse Workers for Justice (https://ww4j.org/) is a worker center founded in 2009 to win stable, living wage jobs with dignity for the hundreds of thousands of workers in Illinois' logistics and distribution industry.

Sinews of War and Trade (http://sinewswartrade.com/) studies the centrality of maritime transport in the global economy, with an emphasis on Middle Eastern ports, especially the ports of the Arabian Peninsula.

The Center for the History of Retailing and Distribution (CHORD) (https://retailhistory.wordpress.com/) focuses on the study of the history of retailing and distribution, acting as a point of contact between scholars engaged in research within this field, whatever their period of interest, discipline or methodology.

Logistical Imaginations

It isn't easy to imagine the supply chain. The supply chain is, after all, not a real thing. It is an abstract structure. What does it mean to see a supply chain? Does it mean to follow the journey of a product from its raw materials to the store shelves? If so, this journey would often require traveling hundreds, if not thousands, of miles, crossing multiple borders, moving through different factories, assembly lines, warehouses, and ports. We would need be introduced to a whole host of individual workers, managers, and drivers. And even this would only be an abstraction—a single crystalized moment in time for a process that is rarely a singular line, but a rapidly shifting maze of pathways, with workers, materials, even designs that are constantly changing. Still, visions of the supply chain allow us to imagine these

crystallizations, to begin to unpack the enormous megastructures responsible for the production of modern life.

Depending on the nature of the representation, it may not necessarily be data source for supply chain investigations per se. A fictionalized film account of mining in the Congo, for example, is a poor substitute for NGO reports on extraction and conflict in Africa. But even in these cases there can be value in using the techniques employed by these representations to convey information for one's own investigation, or in unpacking the discourses on global logistics they surface. Other representations—maps, charts, and illustrations—may be of more direct value, congealing thousands (sometimes hundreds of thousands) data points into a single picture. In either case, these are some of the ways of seeing the supply chain:

Moving Pictures

For Marshall McLuhan, cinema was an assembly line comprised "of still shots on celluloid," where mechanical movement and the projection of light came together to create the "illusion" of motion. Paul Virilio suggested that it was this quality that allowed cinema to "get away from the static focus and share the speed of moving objects." Cinema operated in logistical space, with "fragments" assembled in "non-sensory order." Not in products, but in montage. Cinematic images are powerful, he explains, because, now, "to move was to produce."

Documentary: One frequent, if partial, look at the supply chain is popular exemplified by the Canadian documentary television show "How its Made" which ran from 2001-2019. Similar, earlier examples can be found in Children's television, particular as segments in episodes of Sesame Street and Mister Rogers' Neighborhood. These segments show an edited, documentary-style view of industrial operations behind the making of an often commonplace object. Usually set in factories or similar industrial sites (though sometimes these include agricultural sites), the objects are chosen because they are familiar, present in people's lives, and have relatively contained manufacturing processes. The segment introduces the object, than follows the various industrial operations involved in producing the finished good. How its Made's first episode included segments with, for example, Aluminum foil, Snowboards, Contact lenses, and Bread. Mister Rogers' featured investigations into things like Sneakers, Crayons, Trumpets, and Suitcases. Often accompanied by a voice over narrator, these do a good job of accurately conveying the range of industrial processes, materials, and labor necessary for manufacture, but they are usually limited in scope to a factory or two.

Of course, other (arguably more substantial—though not necessarily more influential) documentaries have examined supply chain issues—from docks and artisanal mining to the massive factories responsible for most of the world's production. These are a few examples:

> **Allan Sekula and Noel Burch, The Forgotten Space (2010); 112 minutes.**
> "The Forgotten Space follows container cargo aboard ships, barges, trains and trucks, listening to workers, engineers, planners, politicians, and those marginalized by the global transport system. We visit displaced farmers and villagers in Holland and Belgium, underpaid truck drivers in Los Angeles, seafarers aboard mega-ships shuttling between Asia and Europe, and factory workers in China, whose low wages are the fragile key to the whole puzzle. And in Bilbao, we discover the most sophisticated expression of the belief that the

maritime economy, and the sea itself, is somehow obsolete." For discussion of the film, see: Alberto Toscano, "The Mirror of Circulation: Allan Sekula and the Logistical Image," *Society and Space* (July 2018) and Jennifer Burris, "Material Resistance: Allan Sekula's Forgotten Space," *Afterall* (June 24, 2011).

Lucy Raven, China Town (2009); 51 minutes.
"China Town traces copper mining and production from an open pit mine in Nevada to a smelter in China, where the semi-processed ore is sent to be smelted and refined. Considering what it actually means to "be wired" and in turn, to be connected, in today's global economic system, the video follows the detailed production process that transforms raw ore into copper wire—in this case, the literal digging of a hole to China—and the generation of waste and of power that grows in both countries as byproduct."

Steve McQueen, Gravesend (2007); 17 minutes.
"The film Gravesend uses a documentary approach to focus on the mining of coltan, employed in the manufacture of cell phones, laptops and other high-tech apparatus. The film cuts between two sites: a technological, highly automated industrial plant in the West where the precious metal is processed for the final production of microelectronic parts, and the central Congo, where miners use simple shovels or their bare hands to extract, wash and collect the ore on leaves. In the Congo, the dirt and clumps of ore are barely distinguishable, while in the industrialized West, the metal is weighed in minute milligrams and cast in antiseptic surroundings."

Natasha Raheja, Cast in India (2014); 26 minutes, Bengali and Hindi, English subtitles.
"Iconic and ubiquitous, thousands of manhole covers dot the streets of New York City. Enlivening the everyday objects around us, this short documentary is a glimpse of the working lives of the men behind the manhole covers in New York City."

Michael Cot, Shipbreakers (2004); 73 minutes.
"Shipbreakers takes the viewer into the heart of Alang, India, a vibrant shantytown where 40,000 people live and work in the most primitive conditions. Since the early '80s, the rusting hulks of thousands of the world's largest ships have been driven onto the remote beaches of Alang, off the Arabian Sea, to be dismantled, piece by piece. Sold for scrap, the ship owners rarely bother to abide by the UN Basel Convention, which bans shipments of transboundary waste. One worker a day, on average, dies on the job, some from explosions or falls, but many will contract cancers caused by asbestos, PCBs and other toxic substances."

Jennifer Baichwal, Manufactured Landscapes (2006); 90 minutes.
"This documentary reveals the gritty underside of industrial landscapes. Photographer Edward Burtynsky explores the subtle beauty amid the waste generated by slag heaps, dumps and factories. Memorable scenes include a Chinese iron factory where employees are berated to produce faster, and shots of children playing atop piles of dangerous debris. The contrasts between wealth and poverty are most striking in Shanghai, with new high-rises towering above old slums."

David Redmon, Mardi Gras: Made in China (2005); 74 minutes.
"The life cycle of plastic beads is traced from their manufacture at a Fuzhou, China, manufacturing facility to their extensive use by revelers at the annual Mardi Gras celebration in New Orleans. Documentary filmmaker David Redmon investigates the low wages and

> substandard conditions endured by the factory's workers, many of whom are young women. Candid interviews with both the Chinese workers and the Mardi Gras crowd reveal the vast economic and cultural chasm between the two."
>
> **Garrett Bradley, Like (2016); 9 minutes.**
> "A short documentary about clickfarmers in Dhaka."
>
> Nick Broomfield, "Ghosts," (2006); 96 minutes.
>
> Peter Galison and Robb Moss, "Containment" (2019); 81 minutes.
>
> **Denis Delestrac, Freightened: The Real Price of Shipping (2016); 90 minutes.**
> "In an audacious investigation, Freightened will reveal the mechanics and perils of freight shipment; an all-but-visible industry that holds the key to our economy, our environment and the very model of our civilisation."
>
> **Frank Piasechi Poulsen, Blood in the Mobile (2010); 83 minutes.**
> "The dark side of our cell phones. No company can say for sure that they didn't buy conflict minerals from the Congo to produce your cell phone."

Tracking Shots: This is the more cinematic equivalent of the perspective offered by shows like How its Made. Popularized by the film Lord of War, which begins with the stamping of shell casings out of sheet metal and ends with the bullet gruesomely fired into the head of a child, this eschews the documentary perspective in favor of a cinematic examination of the movement of materials. In Lord of War, we adopt a bullet-eye perspective, where the camera is situated just behind the bullet as it is formed and continue with that perspective until it serves its intended purpose. As the director, Andrew Niccol, notes, the title sequence is:

> a continuous shot from a camera mounted on the back of a bullet casing illustrating the lifespan of a bullet. Gunpowder is poured into a metal casing, lead slug mounted on top. A bullet is born. A perfect 39mm. The bullet travels along a conveyor belt with thousands of identical siblings in a Ukrainian factory so grey it's monochrome…The crate containing our bullet is placed on a ship in the cold grey Odessa harbor. A container door closes, plunging the bullet into darkness. - The door re-opens. The bullet, still in its crate, now basks in bright, tropical sunshine, surrounded by an azure sea….Our bullet, following close behind, finds its mark, slamming into the boy's forehead just above his left eye, his expression, oddly relieved. The bullet carves through the lobes of the boy's brain where it is enveloped in blood, finally plunged into darkness - the bullet's final resting place.[1]

The use of cinematic connection instead of the abrupt cuts of the documentary footage produces the feeling of a single flowing perspective. But this not only retains some of the limitations of the documentary approach, it adopts all new ones. In Lord of War, for example, we only follow a single bullet, and can begin only when it first becomes bullet-like—as sheets of metal are fed through factory machinery. We see nothing of the supply chain before the factory, though we do follow the horrifying journey the bullet takes afterward—in boats, boxes, crates, and hands And because this is a dramatic, CGI-fueled opening sequence, it is evocative, but it is not especially accurate in terms of the real material details of ammunition manufacture, or the time scale involved in the distribution of the object.

Slow Time: One of the greatest difficulties in representing the flow of supply chains is conveying the time they require. Documentary footage is usually edited, cutting from one moment of activity to another in an effort to concisely represent a sequence of operations. There have been some attempts, however, to show the full scale of logistical operations—often uncut, unedited, and overwhelming long. See, for example:

> Erika Magnusson and Daniel Andersson, Logistics Art Project (2012); 53280 minutes. "A 37 day-long road movie in the true sense of the meaning. The work is about Time and Consumption. It brings to the fore what is often forgotten in our digital, ostensibly fast-paced world: the slow, physical freight transportation that underpins our economic reality. We wanted to convey it in the most direct manner possible in order to share the journey with others. That's why we recorded the journey in real time and screen it in real time. 37 days and 37 nights, nonstop."

As Kyle Stine notes, despite its length the film still "has a recognizable narrative structure, with a clear beginning, middle, and end":

> The time of narration unfolds along a course of movement punctuated by way stations and chance encounters: two days over land by truck and train to the Swedish coast; three days among the idle cranes at the port in Málaga, Spain, during a shipping strike; hours passing through the Suez Canal as water cuts along land for miles and miles; weeks on the open ocean, lines of containers framing an almost motionless scene of water and sky; and finally, a short truck ride from the port in Shenzhen to the factory gates, a transit filled with anticipation for the arrival at the source, which is also the end.[2]

Cinematic Portrayals: Despite the potential for cinema to condense and collect logistical operations, these operations have rarely been central cinematic subjects. Though the Mary Tyler Moore spinoff Lou Grant famously opened its television show with the lifecycle of newspaper production, from the falling of timber to an ignominious end as birdcage liner, in film the logistical labor of the supply chain is more often a backdrop for other human dramas. These are a small number of examples examples in narrative film:

> Alex Rivera, Sleep Dealer (2008).
>
> William Friedkin, Sorcerer (1977).
>
> Steven Soderbergh, Traffic (2000).
>
> Ridley Scott, Alien (1979).
>
> Robert Zemeckis, Castaway (2000).
>
> Edward Zwick, Blood Diamond (2006).
>
> Andrew Niccol, Lord of War (2005).
>
> Terry Gilliam, Brazil (1985).
>
> Alfred Hitchcock, Strangers on a Train (1951)

Games and Interactions

As the introductory manual to SimCity 2000 declares: “Congratulations! By the virtue of owning SimCity 2000 you are hereby proclaimed Mayor of a million cities and ruler of a billion simulated lives (your Sims). It’s a tough game, but somebody’s gotta play it.” Tough or not, the game sold 4.23 million copies. Games frequently include logistical challenges like the management of operations or flows. Logistics, as the architect Buckminster Fuller’s famous “World Game,” first suggested, is a captivating component of simulation.[3]

> **SimCity (1989)**
> “SimCity is the first of a new type of entertainment/education software, called SYSTEM SIMULATIONS. We provide you with a set of RULES and TOOLS that describe, create and control a system. In the case of SimCity the system is a city.”
>
> **A-Train (1985)**
> “A-Train is a simulation game built upon trains and railroad management—but that’s just the beginning! A-Train exemplifies the relationships between transportation, business, and city development.”
>
> **OpenTTD (2004-)**
> “OpenTTD is a business simulation game in which players try to earn money via transporting passengers and freight by road, rail, water and air. It is an open source remake and expansion of the 1995 Chris Sawyer video game Transport Tycoon Deluxe.”
>
> **Cargonauts (2015)**
> “Part of the Logistical Worlds Project, Cargonauts envisions a logistical world of infrastructure, of transport economies, of zones and concessions, of nocturnal possibilities for sabotage and revenge.”
>
> **Phone Story (2011)**
> “Phone Story is an educational game about the dark side of your favorite smart phone. Follow your phone’s journey around the world and fight the market forces in a spiral of planned obsolescence.”
>
> **TransOcean (2014)**
> “TransOcean – The Shipping Company is your ticket to the world of gigantic ships and transnational transport empires. Build a mighty fleet of modern merchant ships and conquer the seven seas. Track your routes and real time, take the controls as ships enter and leave the harbor, and see to it that freight gets loaded efficiently. Keep in mind that time is money!”

Art

As Michael Shane Boyle writes in his *The Arts of Logistics, “*Since the 1950s, Capitalism has come to rely, increasingly, on logistics. So too has art. With the astounding rise of the international art market and gallery system, more paintings, sculptures, and performances circle the globe than ever before. Art might not be a commodity like any other, but it certainly can move like one. The connection with logistics extends beyond the widening scale of art's

circulation, as circulation has become a factor in the very production of art itself, dictating and delimiting what gets made and how-not to mention where, when, and by whom. Many are the ways that art is entangled in supply chain capitalism."[4]

Allan Sekula, *Fish Story*, (Düsseldorf: Richter Verlag, 2002).
"…the Ark is no longer a bestiary but an encyclopedia of trade and industry. This is the reason for the antique mercantilist charm of harbors. But the more regularized, literally containerized, the movement of goods in harbors, that is, the more rationalized and automated, the more the harbor comes to resemble the stock market. A crucial phenomenological point here is the suppression of smell. Goods that once reeked—guano, gypsum, steamed tuna, hemp, molasses—now flow or are boxed. The boxes, viewed in vertical elevation, have the proportions of slightly elongated banknotes. The contents anonymous: electronic components, the worldly belongings of military dependents, cocaine, scrap paper (who could know?) hidden behind the corrugated sheet steel walls emblazoned with the logos of the global shipping corporations"

Gabby Miller, "Turquoise Wake," Oakland, Random Parts (2015).

Pieter Hugo, Permanent Error (London: Prestel, 2011).
"In his previous volumes of photographs, Hugo offers unflinching yet striking portraits of humans, animals, societies, and landscapes that shock and disturb, but also demand our attention. In Permanent Error, he documents a garbage dump in Ghana that has become the repository for discarded computers from around the world."

A. Laurie Palmer, In the Aura of a Hole: Exploring Sites of Material Extraction (New York: Black Dog, 2015).
"In the Aura of a Hole focuses on a decade long project Palmer undertook as an extended exploration of mineral extraction sites in the U.S, which through her narration of a first person perspective, discusses themes of the raw scientific and mechanical aspects of the industry."

Michael Shane Boyle, "Container Aesthetics: The Infrastructural Politics of Shunt's 'The Boy Who Climbed Out of His Face'," *Theatre Journal* 68.1 (March 2016).

Chen HangFeng, Santa's Little Helpers (2007); 9 minute video installation.
"The video is shot in a small village in Zhejiang Province, (China) where 50% of the world's Christmas decorations are made by hand. The family workshops were doing the ornaments all year along and the landscape had been littered with garbage. The video has been edited into a 9-minute video and screened it inside a small wooden box wrapped like a Christmas present, people only can see the secret from a small peep whole on the box."

Lonnie Van Brummelen and Siebren De Haan, Monument Of Sugar: How to Use Artistic Means to Avoid Barriers (2007); 67 minute video installation.
"Upon learning that most of Europe's beet sugar today is consumed outside its borders, the artists devised a plan that began with purchase of that same sugar at a fraction of its domestic price. From there, they set out for Nigeria, a nation which, despite a climate wholly conducive to sugarcane cultivation, was said to be the largest importer of European sugar. Van Brummelen and de Haan's idea was to transform that raw material into art and reimport it for an exhibition at the Stedelijk Museum."

Samuel Pelts, "Extraction: The Megazine" Extraction Art (2021).

Tiffany Sia, “Slippery When Wet,” Artists Space (2021).

Mari Bastashevski, “10.000 Things out of China (2016).[5]

Simon Denny, “Mine,” Petzel (2021).

Literature

To suggest, as Sam Halliday does, Bram Stoker’s epistolary novel as one of the “logistical sublime,” is to recognize its peculiarly modern fascination with time. “Left Munich at 8.35 p.m. on 1st May,” the first line reads, “arriving at Vienna early next morning; should have arrived at 6.46, but train was an hour late.” As a result of the encounter, Halliday notes, Harker’s interest in “the correct time” will become a near-obsession. Indeed, Dracula is a sequence of events, near misses, and long delays punctuated by sudden collisions. Like the examples below, it is a story of the mediation of movement in space and time, of storage and transmission in sites both recognizably logistical and not.[6]

Bram Stoker, Dracula (1887).

Joseph Conrad, Heart of Darkness (1899).

Leo Tolstoy, Anna Karenina (1877).

Joseph Conrad, “An Outpost of Progress” (1897) and Heart of Darkness (1899).

Herman Melville, Moby-Dick; or, The Whale (1851).

John Steinbeck, The Grapes of Wrath (1939).

Philip K. Dick, “Adjustment Team” (1954), Time Out of Joint (1959), and many others.

Ray Bradbury, “A Sound of Thunder” (1952), “The Toynbee Convector” (1984), and many others.

Jack Kerouac, On the Road (1957).

Jorge Luis Borges, “The Lottery in Babylon” (1962; in English).

William Burroughs, Nova Express, 1964

William Gibson, “Johnny Mnemonic” (1986).

Ursula K. Le Guin, “Sur” (1982), Changing Planes (2003), and many others.

Annie Proulx, The Shipping News (1993).

Umberto Eco, The Island of the Day Before (1994).

Mark Danielewski, House of Leaves (2000).

Ted Chiang, “Tower of Babylon” (1990).

Paolo Bacigalupi, “The People of Sand and Slag” (2004).

China Miéville, Iron Council (2004), The City & the City (2009).

Notes

[1] Andrew Niccol, “Lord of War” screenplay (2005).

[2] Kyle Stine, “Nonhuman Cinema and the Logistical Sublime,” *October* 177 (Summer 2021).

[3] For further discussion of logistics and games, see Ned Rossiter, “Logistical worlds,” Cultural Studies Review 20, no. 1 (2014): 53–76.

[4] Michael Shane Boyle, *The Arts of Logistics: Artistic Production in Supply Chain Capitalism* (Stanford University Press, 2024).

[5] See also “Gestures of Potentiality: An Introduction to Distributed Utopias,” *EastEast* (2021).

[6] For additional discussion on logistics, infrastructure, and literature, see: Kate Marshall, *Corridor: Media Architectures in American Fiction* (University of Minnesota Press, 2013).

VIII. Glossary and Keywords

This section presents a brief list of terms and keywords in logistics, supply chain management, and operations research. Anyone researching and writing about supply chains can benefit from understanding the complex and often obtuse terminology that is used in the industry.

Subcontractor / Subcontracting: Subcontracting is when a company agrees to contract with another company to manufacture a product (or a part or component of a product), or to carry out a service (in our context, usually some kind of logistics or manufacturing service like finishing or packaging). The secondary company is called a subcontractor, a supplier, or a partner. In manufacturing this contract usually defines details like the quantity, type, quality, deadline, and price for delivery. The primary company will often sell the product as their own, and consumers or buyers may not be aware of the subtractor relationship.

Retail / Retailers: Retailers are companies which sell to consumers, usually the general public. Retailers will often own a chain of stores. They may sometimes operate in multiple companies (either directly, or through subsidiary companies). They may also (or only) sell their goods through mediums like mail order or online platforms. Generally speaking, retailers do not make the goods they sell, though some retailers may have brand labels which are known and exclusive to them and which are provided by subcontracted manufacturers, growers, etc.

Labor Networks: In an industry context, labor networks refer to groups of smaller agents who enter into subcontracting relationships with other companies. In garment production, for example, these networks might perform operations like stitching or finishing. Sometimes these networks are comprised of small factories (which could sometimes be described as sweatshops), but they could also be individuals, homeworkers, etc. This is not exclusive to the garment industry. Apple Computer utilized a labor network of what were euphemistically described as Silicon Valley Housewives (but which were also immigrant women) for the board assembly for the original Apple II computer.

Manufacturers: Manufacturers organize the making of goods. Traditionally this means they employ the laborers, own the machinery, and develop the techniques necessary to produce finished goods at scale. They may produce these goods entirely in house (through workers and factories under their direct control), but many frequently subcontract significant portions of this work to other companies. While some manufacturers may sell directly to consumers or other businesses, most will work with retailers to sell finished goods to consumers. If a manufacturer is operating under contract to another firm, it is a subcontractor.

Tiers: Most supply chains are imagined as a series of tiers, based on a company's closeness to the final product or to the client they are working with. The first tier (Tier 1) is the top of the supply chain—it is the final product (or at least the final product that company delivers). Tier 1 suppliers are those companies that are direct suppliers of the final product, Tier 2 suppliers are those companies' suppliers or subcontractors, and Tier 3 are those companies' suppliers

or subcontractors, and so on down to tier 4 and more—however many steps exist between the final product and its raw materials. A company selling a cotton T-shirt would describe the companies producing T-shirts for them as Tier 1 suppliers, the cotton mills supplying the Tier 1 companies would be Tier 2 suppliers, and the farms growing cotton to be sent to the mills might be Tier 3, and so on.

Upstream / Downstream: Related to the idea of supplier tiers is the idea of upstream and downstream. If you imagine the supply chain as a a chain, you could talk about the direction of movement within that chain from raw materials to finished goods and consumer purchased. Upstream refers to movement toward the raw materials of the supply chain, and downstream refers to movement toward retail and consumption.

Traceability: Traceability, Mario Rautner writes, is "the passing of information from one stage in the supply chain to the next. This can relate to the initial source of the ingredients or raw material of a product, the alterations it incurred along the way, or other relevant details that may help trace an entire history of transportation and production. Some companies have systems for this but many supply chains are so long and complicated that it can be difficult even for the companies directly involved to achieve a fully traceable supply chain."