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Capital's Media: The Physical Conditions of Circulation

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Abstract

The question of what constitutes media has received little attention in Marxism and where it does, the concept is an empty abstraction. While Marxists have extensively theorized the concentration of mass media ownership, and analyzed mass media content as ideology or propaganda, critical discussions of what a medium *is* in the capitalist mode of production have been mostly lacking. That is to say, Marxism does not have a media ontology. Media is therefore a critical gap in Marx's political economy. This dissertation seeks to fill this gap by asking what is a medium in the capitalist mode of production?, answering it with a value-form theory of media and a concept of "capital's media" that takes the circulation of capital as its starting point. The dissertation goes beyond Marxism's mass media myopia and moves the concept of media towards logistics and infrastructure.

The contributions this dissertation makes are to (1) develop a theory and category of capital's media as a phenomenon of the circulation process of capital; (2) stake out an approach to investigate media phenomenon outside of pure political economy and cultural studies approaches; and in the process (3) contribute towards a rehabilitation of Marx's analysis of circulation. To make these contributions this dissertation relies on a theoretical framework that is primarily based on Marx's value theory, but enriched with concepts from Canadian-German media theory (Harold A. Innis, Marshall McLuhan, Friedrich Kittler, Wolfgang Ernst, and Hartmut Winkler) and Paul Virilio's dromology. This dissertation has two components to its methodology: an original "circulationist" reading of Marx's political economy that is developed from the heterodox *Neue Marx-Lektüre* (New Marx Reading), and a set of empirical case studies that includes the shipping container and intermodal transportation, distribution centers, and point-of-sale and payment systems

Positing a category of capital's media, this dissertation concludes that nothing by its very nature is a medium but instead that things function as media when they appear in that category. More specifically, a thing, such as a container ship or distribution center, appears in the category of capital's media when they function within and for the circulation process.

Keywords

Marxism, Media Studies, Media Theory, Marx, Political Economy of Media, Value Form Theory, Circulation, Movement, Logistics, Intermodal Transportation, Distribution Centers, Point-of-sale systems.

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Introduction: Marxism and Media Studies

The question of what constitutes media has received little attention in Marxism. Although Marx wrote about media, he never gave the topic a systematic treatment, and while Marxists and Marx-inspired political economists have extensively theorized the concentration of mass media ownership, and analyzed mass media content as ideology or propaganda, critical discussions of what a medium *is* in the capitalist mode of production have been mostly lacking. That is to say, Marxism does not have a media ontology. The question ‘what is a medium in the capitalist mode of production?’ should be asked. This dissertation poses that question, and answers it with a Marxist theory of media, or more precisely a *value* theory of media that takes the circulation of capital as its starting point.¹ In this dissertation, I argue that it is possible to speak of media only as a phenomenon of circulation. The purpose of this dissertation is to develop a theory and concept of “capital’s media” that is native to Marx’s value theory, but at the same time partly derived from the theoretical framework of the Toronto school of communication (Harold Innis and Marshall McLuhan), media archeology (e.g. Friedrich Kittler, Wolfgang Ernst, and Hartmut Winkler), and Paul Virilio’s science and logic of speed (dromology).² Before I continue with introducing the topic of this dissertation, I present a cautionary tale.

A cautionary tale

In the early 1980s, a debate over Canadian political economy and the respective contributions of Karl Marx and Harold A. Innis was sparked by a special issue of *Studies in Political Economy*. In it, Leo Panitch (1981), Ray Schmidt (1981), and David McNally (1981; see also 1986) critiqued Innisian-inspired analyses of Canadian capitalist

¹ The circulation of capital refers to the buying and selling of commodities, and of the transformation of capital from the form of the commodity into money and back again. Capital’s circulation process is the antithesis to its production process where value is created.

² I refer to the Toronto school and media archaeology together as Canadian-German media theory or just media theory.

development, dependency, and attempted to synthesize Innis with Marx. These critiques garnered spirited responses from Daniel Drache (1982; 1983), Mel Watkins (1982), and Ian Parker (1983), who defended the relevance of Innis and attempts at Marxian synthesis.³ While the respective critiques of Panitch and Schmidt were constructive and sympathetic, McNally played the part of the stereotypical orthodox Marxist who is hostile to other theoretical frameworks and prone to invoke the epithet of ‘fetishist’.⁴ Indeed, McNally *did* call Innis a fetishist and referred to his staples theory as “vulgar materialism” (1981:56). And due to Innis’ concern with trade, exchange, and things’ material characteristics, McNally charged him with failing to understand capitalism as a historically specific mode of production by reducing capitalism to “the sphere of commodity circulation”, and thus of grasping it as a fetishistic relation among things (1981:41, 50).⁵

McNally, therefore, took particular umbrage with Parker’s (1977) suggestion that a synthesis of Marx and Innis should be done at the level of circulation, calling it a “fundamentally misguided effort”; *real Marxists* are apparently concerned only with production and class (1983:38). In responding, Parker (1983:145-7) countered that McNally espoused a “vulgar Marxism” with “seriously flawed” arguments riddled with factual errors, misreadings, selective quotations, and reductionist interpretations of Marx as well as Innis. Parker attacked McNally in particular for his “total failure” to come to grips with Marx’s “important and demanding analysis of circulation” (Parker 1983:160).⁶

³ One of the core issues of the debate was whether there was any common ground and mutual points of relevance between the Marxist perspective of class struggle and the Innisian one of dependency on staples.

⁴ For another example of Marxist hostility to other theoretical frameworks, see Silvia Federici and George Caffentzis’ (1987) “review play” on Paul Virilio and Sylvere Lotringer’s *Pure War*.

⁵ In a nutshell, McNally’s argument can be boiled down to the simple argument that Innis was not a Marxist and therefore the twain shall never meet.

⁶ Despite McNally’s insistence on the contrary, Parker (1983; see also Drache 1983) also gives textual evidence demonstrating that Innis did write about class and conflict with reference to the production of staples, and thus, that a staples approach does not divert attention away from production and class.

I share Parker's frustration with McNally's almost ritualistic argument that anything occurring in the sphere of circulation is uninteresting surface phenomena. After all, Marx conceived of the relationship between production and circulation as reciprocal, effectively arguing exploitation amount to nothing without circulation (1978:205). A pure focus on production only tells half of the story Marx was telling.

Why is this debate over the direction and spirit of Canadian political economy a cautionary tale for a dissertation seeking to develop a concept and theory of capital's media? As I argue in this dissertation, capital's media is a phenomenon of circulation and must, therefore, be analyzed with reference to the sphere of circulation (the sphere of exchange and logistics) and in terms of the circulation process of capital (selling, buying, and movement). Following Innis, such an analysis must pay attention to the material characteristics of the things that function as capital's media. In addition, because Marxism lacks a media ontology, it is necessary to borrow from the framework of Canadian-German media theory that is in part devoted to exploring the ontology of media (Parikka 2012).

The Innis-Marx debate is thus a cautionary tale for this dissertation because I am doing precisely those things a Marxist is not supposed to do according to McNally: focusing on supposedly negligible aspects of Marx analysis (circulation) and borrowing from non-Marxist theoretical frameworks. But taking the risk of being shunned by my own is necessary to make an original intervention in Marxist media theory; the contributions this dissertation makes is to (1) develop a theory and category of capital's media as a phenomenon of capital's circulation process; (2) stake out an approach for Marxists to investigate the media phenomenon outside of cultural studies and political economy approaches that focus purely on labour and production; and in the process (3) contribute towards a rehabilitation of Marx's analysis of circulation.⁷

⁷ Marxism arguably has a production bias, which leads to an overemphasis on labour, the creation of value, teleological class struggle narratives, and may lead to arguments like those of McNally. As a consequence, circulation is arguably under-theorized in Marxism. It is telling that in the introduction to the English translation of *Capital Vol. 2*, in which Marx discusses the circulation process of capital, Ernest Mandel referred to it as the forgotten book (1978:12) and a reviewer of the translation styled it the "unknown

I now turn to a short review of the literature on Marxist media studies before presenting this dissertation's theoretical framework, methodology, and research questions. I conclude this introduction with a chapter breakdown and a note on the status of labour and human beings in this dissertation.

Literature review

The purpose of this literature review is to situate this dissertation within an already existing approach in Marxist media studies that stakes out a course independent of (1) cultural studies approaches that focus primarily on the mass media and issues of identity, representation, and ideology, and (2) political economy approaches that focus on labour in (mass) media industries, the implications of conglomeration on democracy, the production of culture, and so on. I develop the theoretical framework of this dissertation based on this third approach that I term "circulationist." This approach, however, does not displace cultural studies or the concerns of more traditional political economy approaches, but should be understood as complementary. I neither pretend nor want this dissertation to be the final word on Marx and the media.

In this dissertation, the reader will find a discussion on an array of things and systems—shipping containers, intermodal transportation, distribution centers, point-of-sale systems—that are very different from what is usually thought to constitute the proper objects of media studies. In developing a category and theory of *capital's media*, I am consciously trying to defamiliarize the taken-for-granted understanding of the media as mass media to include the logistical or infrastructural aspects of capital. The implications of this approach for media studies in the wider sense means that, for example, the concerns about identity, subjectivity, and representation in cultural studies should be understood in relation to the circulation of capital. For example, a cultural studies

volume" (cf. Arthur and Reuten 1998:1). Even in the otherwise excellent *Introduction to the Three Volumes of Karl Marx's Capital*, Heinrich (2012:131-141) devotes a mere ten pages to the circulation process of capital.

analysis of Facebook's introduction of 71 different gender options in 2014 can be interpreted as resisting the gender binary and allow people to more accurately represent their "self." But when it comes to the circulation process of capital, these genders should be understood as a logistical resource that can be used to match commodities better with potential buyers which enhances the vector of capital's circulation. While this dissertation approaches media through the lens of political economy, it focuses neither on profit and loss in (mass) media companies and sectors, nor the conditions of labour in these sectors. Instead, this dissertation investigates the definition of media and the overall role of media in relation to capital as a whole. I return to the implications of circulationist media theory on cultural studies and political economy in the final chapter of this dissertation.

According to Robert McChesney "no one has read Marx systematically to tease out the notion of communication in its varied manifestations" (2007:235f, fn 35). The same can be said about the associated notion of "medium." The late 1970s, however, saw the arrival of several texts that suggested how such a systematic interpretation could be accomplished. These contributions include Dallas Smythe's (1977) audience commodity thesis and the more circulation-oriented approaches of Nicholas Garnham ([1979]1990), Yves de la Haye (1979), and Parker (1977; 1981). While the latter three contributions appear to have mostly fallen on deaf ears, Smythe's approach found fertile ground and is today a touchstone of the digital labour debate (see e.g. Manzerolle 2010; Caraway 2011; Fuchs 2012; McGuigan and Manzerolle 2014). More recently, a handful of Marxist media and communication scholars (Fuchs 2009a; 2009b; 2011; Fuchs and Mosco 2012b; Manzerolle and Kjøsen 2012; 2014; 2015) have followed in the footsteps of Garnham, de la Haye, and Parker.

The respective contributions of Smythe and Garnham were reactions to the then-dominant paradigms in Marxist media studies that they felt gave only a partial analysis of communications and media in the capitalist mode of production. Smythe (1977) argued these phenomena constituted a "blindspot" in Western Marxism because it was dominated by subjective and idealist concepts that defined the products of mass media as messages, meaning, and manipulation. According to Smythe, such concepts dealt with "superficial appearances"; he, therefore, called for pursuing a materialist theory that

focused on production and the commodity form of mass communication (1977:2). A couple of years later, Garnham ([1979]1990) concurred with this assessment that Marxist media studies was dominated by idealism and the base-superstructure problematic, but he also considered Smythe's contribution to be one-sided in its pure focus on production. Instead, Garnham called for an approach based on Marx's understanding of capital as a process. Before I turn to the particulars of this literature from the 1970s, I note that almost four decades later Garnham's critique is still valid and Marxist media studies is still dominated by ideology, subjectivity, and production-centric analyses with reference to a few key works on Marx, media, and communications.

Mike Wayne's (2003) *Marxism and Media Studies: Key Concepts and Contemporary Trends* is a case in point. While the book is an excellent example of how the concerns of cultural studies and political economy can effectively be brought together, it is focused on how capitalism determines media practices (including labour) and structures, the meanings of media texts, and the fate of knowledge and consciousness. Wayne does not discuss what a medium is and assumes it refers to mass media, and limits his case studies to print, TV, the internet and so on. The anthology *Marxism and Communication Studies* (Artz, Macek, and Cloud 2006) covers similar ground as that of Wayne's monograph, but additionally considers the impact of mass media conglomeration on democracy and social change, and addresses some methodological concerns.

Similarly, the journal *triple C's* special issue "Marx is Back: The Importance of Marxist Theory and Research for Critical Communication Studies" (Fuchs and Mosco 2012a) covers a broad range of topics, but it is nevertheless dominated by themes of ideology, production, labour, and resistance.⁸ The few notable exceptions include Vincent Manzerolle and Atle Mikkola Kjøsen's (2012) discussion of digital media in terms of capital's logic of acceleration in the sphere of circulation; Gerald Sussman's essay on ideology and propaganda through a partial prism of acceleration and circulation; and

⁸ This special issue was later turned into the two edited collections *Marx in the Age of Digital Capitalism* (Fuchs and Mosco 2015a) and *Marx and the Political Economy of the Media* (Fuchs and Mosco 2015b).

Christian Fuchs and Vincent Mosco's (2012b) editorial introduction, which seeks to systematize media and communication in relation to the circuit of capital.⁹

Other notable Marxists' works on media and communication include Peter Golding and Graham Murdock's (1997) two-volume reader *The Political Economy of the Media*, in which media and communications are critically analyzed primarily through the lens of ideology, globalization, and public goods. There is, however, little direct engagement with Marx's thought, the texts are mainly concerned with the mass media, and do not engage with Marx's broader understanding of communications as including transportation (see e.g. Marx 1978:134). Armand Mattelart and Seth Sieglaub's (1979; 1983) two-volume anthology *Communication and Class Struggle* is directly focused on the relationship between communication and domination in the capitalist mode of production (Vol. 1), and various struggles against capitalism, fascism, and imperialism (Vol. 2). The second volume includes communiqués as well as texts on communication technology and strategies from various historical struggles across the world. While an excellent historical resource for approaching communication from the point of view of class struggle, the two volumes do little to clarify how Marx understood communication and the media.

Smythe's (1977) original contribution to Marxist media studies was that he called for an analysis based on production that focuses on the product of the mass media. Rejecting that this product is messages or entertainment, Smythe argued that the mass media produces audiences to whom commodities, candidates, and issues are marketed. In other words, mass media's product is the audience, which is a commodity sold to advertisers. At the same time as the audience is produced, Smythe contends that the audience also works by consuming advertisements. This work pays off for the advertiser when the former audience member buys an advertised commodity. Consequently, Smythe argued that the role of the mass media is to make the capitalist mode of production function

⁹ Fuchs and Mosco (2012b) is, however, a version of Fuchs' media typology that he has published several times with more or less variation (2009a; 2009b; 2011:135-160). I discuss these texts and Manzerolle and Kjølseth's contribution in more detail below.

through demand management (1977:19). While this dissertation does not rely on the audience commodity as a concept, it shares Smythe's focus on the role or function of media and his central insight that this role concerns selling, which is a moment of circulation. In making this connection, however, it is necessary to turn to the specifics of how Garnham, de la Haye and Parker independently of one another suggested an approach that is based on the circuit or the circulation of capital as necessary for analyzing the phenomenon of media and communications in the capitalist mode of production.

Garnham called for an approach that returns to Marx's "central notion of process, or flow" and how capital as a process is "continuous, circular and through time" (1990:45). He argued that Marxists often rely on a fetishized distinction between production and circulation to the point of near complete neglect of the latter, which is problematic because capital can only be understood "in terms of the contradictory interaction between moments within the total process" that is capital (1990:46). Commodities that are produced in the sphere of production are sold in the sphere of circulation, and the elements of production required to keep production going must also be bought in the sphere of circulation. Garnham, therefore, suggested that the circuit of capital, which represents capital as a total process and unity of production and circulation, should be the point of departure for Marxist approaches to media and communication. De la Haye made precisely the same argument and posited that the communication question "can only be understood in terms of the relations between production and circulation" (1979:12).

Whereas Garnham asserts that most media phenomena (e.g. media piracy and the transition from broadcast to cable) can be analyzed by focusing on the "physical, spatial and temporal transitions through which capital is forced to pass (1990:45), de la Haye argues that the reciprocal relationship between production and circulation becomes apparent in investigating what Marx termed the "means of communication and transport," that is, the "vast ensemble" of "material transportation infrastructure (roads, ports, railroads), the means of locomotion (steam engines, steamships, locomotives)... and finally the instruments of transmitting information" (1979:12). Garnham also argues for a move beyond the focus on the mass media, but with a more general focus on

transportation and storage as moments of capital's circulation (1990:46-7). Both Garnham and de la Haye make tantalizing mentions of Marx's concept of "barrier" as significant; de la Haye also includes the concept of the "general conditions of production" as salient for a circuit-based approach to Marxist media studies.

Parker (1977; 1981) makes Garnham and de la Haye's suggestions more explicit. Drawing inspiration from Innis' staples theory and later work on communications, Parker argues for the central importance of *Capital Vol. 2* for analyzing communication and media because it "treats the sphere of circulation of commodities in terms which emphasize in considerable detail the role of communications in capitalist development" (1981:138).¹⁰ He, therefore, argues that attention should be focused on "the sphere of circulation" and, in agreement with de la Haye, that particular attention should be given to the "communication networks (transportational, informational, and financial) that have historically determined the character of the circulation process" (1981:134).

Importantly, Parker emphasizes the "two-fold role" that communication and transport play in Marx's theoretical system, by being both an independent branch of production and a process occurring within the sphere of circulation (1981:138). As I argue in the methods section, this liminal ontological status of the means of communication and transport makes it possible to interpret things that typically would be considered as machinery, such as a truck or container ship, as capital's media, but only if a circulationist point of view is adopted. Like Garnham, Parker also identifies transportation and storage as communicative or media functions vital for the circulation and reproduction of capital in space and time. Significantly, Parker argues for the

¹⁰ Parker thus agrees with John Durham Peters' (1999:125) argument that although Marx did not discuss communication in a sustained way, traffic or exchange is "the closest Marx gets to naming communication." Armand Mattelart (1996:101) makes a similar argument in *The Invention of Communication*. During Marx's time the German word *Verkehr* was used as a synonym for what the French called communications, and Marx deployed this word in the sense of "commerce" and "social relations". Thus Mattelart argues that "if one is bent on finding in Marx the traces of the term 'communication' in its current meaning, one would have to include all the forms of relations of work, exchange, property, consciousness, as well as relationships among individuals, groups, nations and states" (1996:101).

necessity of drawing on other theoretical frameworks, such as Innis', to resolve "critical gaps in Marx's theory" (1981:139).¹¹ While media never were a focus for Marx, it is nevertheless a critical gap that should be filled with concepts, categories, and insights from other theoretical frameworks.

It was not until three decades after the respective contributions of Garnham, de la Haye, and Parker that other Marxist scholars (Fuchs 2009a; 2009b; 2011:135-160; Manzerolle and Kjøsén 2012; 2014; 2015) continued the approach just sketched. Although Fuchs (2009a; 2009b; 2011:135-160) distances himself from Garnham and de la Haye, his argument that a systematic location of media in capitalism should use the circuit of capital as a point of departure clearly follows in their footsteps. And so does his call for going beyond the ideology and mass media myopia in favour of including infrastructure and transportation vehicles as media phenomena (2009a:373).¹² Fuchs' original contribution, however, is to use the circuit of capital to develop a typology of media that systematically accounts for media based on its roles in (1) commodity production, (2) commodity circulation, (3) media and ideology, and (4) alternative media (2009a:379).

The advance Fuchs makes on Garnham, de la Haye, and Parker is to consider what a medium is in the capitalist mode of production with reference to general and particular roles. Fuchs' contribution, however, demonstrates that a circuit-centric approach is not necessarily any more rigorous or systematic than ideology- or production-centric ones. The circuit of capital provides Fuchs with a mere semblance of systemization because in

¹¹ Specifically, Parker (1977; 1981) argued for applying Innisian concepts such as unused capacity, rigidities, fixed capital, and overhead costs for a more rigorous analysis of circulation. While I agree that these concepts can serve as the basis for a Marx-Innis synthesis, this dissertation eschews these concepts in favour of a more general focus on Canadian-German media theory's elaboration of the media functions of transfer, storage, and processing.

¹² Even as he cites both Garnham's and de la Haye's essay, Fuchs (2009a:375-7) does not recognize that his arguments for justifying his media typology are strikingly similar to Garnham and de la Haye's arguments for using the circuit of capital. Fuchs also exhibits a typical hostility towards non-Marxists; in particular those who critique Marx. For example, Fuchs dismisses Peters' reasonable argument that the closest Marx comes to discussing communication is traffic and exchange (see note 10) as "not true" (2009a:373). He takes similar, albeit more justifiable, stabs at McLuhan and Baudrillard.

his typology media can be just about anything, is assigned too many different roles, and even subsumes Marx's concept of machinery. Fuchs can consequently be accused of a certain fetishism of media; he finds things that are predefined as media, such as the mass media, computers, transportation, and infrastructure, and then assigns them a function or role in the circuit of capital. Accordingly, media is machinery, a commodity, the general intellect, and much more. As I argue below, this is precisely the opposite of Marx's approach, which starts with functions that are expressed in specific categories in which things appear (1978:303). Accordingly, media is not something that things inherently are, but is something that they function as depending on their relative position in the circuit of capital.

In his desire to systematize media, Fuchs' account becomes unsystematic by indiscriminately assigning the term to everything and having these media do everything, with the result that it explains almost nothing. While the concept of media in Marxism must go beyond just referring to mass media, it must be narrow enough to have explanatory power. I argue that this narrowing can be done by limiting media to a phenomenon exclusive to circulation. Fuchs nevertheless had the correct intuition on focusing on the *role* of media in relation to the circuit of capital. He does not, however, pursue this insight to its logical conclusion by considering how the role of media can be connected to how capital moves through its circuit by fulfilling the respective *functions* (selling, buying, and valorizing) associated with each of capital's particular forms.

Manzerolle and Kjøsen (2012; 2015) build on Garnham, Parker, and Fuchs by using the circuit of capital as a core analytical concept, arguing that the circulation process of capital should be understood as a process of communication and in terms of acceleration. They discuss media as phenomena of circulation and argue, albeit without much justification, that media can be thought of as the conceptual counterpart to machinery in production. Specifically, Manzerolle and Kjøsen (2012; 2015) argue that the function of media is to overcome the barriers of space and time in the sphere of circulation, although they leave this argument mostly undeveloped. In another article on the function of apps in the capitalist mode of production, Manzerolle and Kjøsen (2014) reiterate their circulationist approach by considering how the extraction of information from

consumers' use of smartphones and tablets is used to accelerate the circulation of capital by matching commodities with particular consumers.

What is missing from this circuit or circulation-centric approach is that it lacks a clearly defined concept or category of media. At best these theories operate with a media category that is synonymous with Marx's concept of the "means of communication and transport" and the mass media; at worst the category of "medium" is so expansive that it explains nothing. I reiterate: Marxist media studies operate with a category of media that is empty; Dallas Smythe's contributions notwithstanding, media is still a blind spot in Marxism because it lacks a media ontology.¹³ The purpose of this dissertation is to develop a concept and category of *capital's media* that is filled with content. But with what type of content should this category be filled?

First, the category must be developed in a manner similar to how Marx developed his economic categories or social forms as expressions of specific functions and relations. I discuss this particular point in more detail in the methodology section. Second, I argue that capital's media is a phenomenon that is limited to the sphere and process of circulation, which means that capital's media as a category must be filled with circulatory content. Based on the literature review, this includes capital's physical, spatial, and temporal moments; functions like transportation and storage; communication networks and the means of communication (infrastructure, and vehicles); barriers to circulation; the two-fold nature of transportation; and the general conditions of production. Also, because circulation is a process in which value changes economic form from a commodity into money and back again, which occurs in and through the respective functions of buying and selling, means that these economic forms and functions must also be considered in relation to capital's media. While the sphere of circulation is almost synonymous with the market, the process of circulation also includes the material movement of commodities

¹³ Marx illustrates what an empty category is with reference to the category of "population", arguing that it is an empty abstraction without consideration of class (1973:100). In turn, class is an "empty phrase" if elements such as wage-labour and capital are not included, and in turn these latter categories "presuppose exchange, division of labour, prices etc." (1973:100). It is from nesting these categories that Marx argues that the category of population becomes "a rich totality of many determinations and relations" (1973:100).

and money in time and space (Marx 1976:270; 214-28). The sphere of circulation consequently also refers to the material domain of logistics, which is a phenomenon that also fills the category of capital's media with content.

Theoretical framework: new materialist analysis of circulation

The theoretical framework of this dissertation is primarily based on Marx's value theory and the circulation-centric approach to media as sketched out in the literature review, but is also enriched by insights, concepts, and theory from Canadian-German media theory and Virilio's dromology. From the former tradition, I draw on Innis' "economics of communication" and the media archeological approach that Jussi Parikka (2012:63) qualifies as new materialist. I situate the general Marxist orientation of this dissertation next to new materialist media theory to develop a theoretical framework I refer to as a new materialist analysis of circulation. In turn, this framework is used to develop and delineate the category of capital's media. Considering that a purpose of this dissertation is to develop a theory of media, this theoretical framework is not elaborated in full until the sixth and concluding chapter.¹⁴ At this juncture, I present how Canadian-German media theory's emphasis on the ontology or functions of media in terms of transfer (transportation and transmission), storage, and processing can be used to elaborate how capital's media *materially* mediate the circulation process of capital in time and space.

Before I turn to new materialism, I first comment on how Canadian-German media theory's fragmentation of the conventional understanding of what constitutes media was influential in my choice of developing a category and theory of capital's media. In addition to writing about more traditional media like radio and the printing press, Innis referred to roads, monuments (sculpture), architecture (e.g. the pyramids), and even institutions like priesthoods and the state as media (2007; 2008; Parker 1981:137). McLuhan (1994) listed numbers, chairs, wheels, clocks, and clothing as medial

¹⁴ Although the influence of new materialist media theory is made overt in the later chapters, the influence is covert in the earlier chapters.

extensions of man. In this dissertation, I consider things like shipping containers, distribution centers, barcodes, and payment systems like VISA as examples of things that function as capital's media. Although Marx's ([1845]1998:572-4) critique of political economy is *reductio ad hominem* by pointing back to Man as the root of all things, the media that this dissertation conceptualizes always lead back to capital in its commodity and money forms as the content of what I qualify as *capital's* media.

In abandoning Marx's anthropological orientation, I take a cue from Kittler, who questioned the assumption that "the subject of all media is naturally the human" as "methodologically tricky" (2010:30). He argued that media studies should not be limited to studying media that "have a public, civilian, peaceful, democratic and paying audience" (Kittler 2010:32). Against Werner Faulstich's argument that closed circuit television systems (CCTV) is of peripheral importance to broadcast television in media studies, Kittler points out that the possibility of private recording of television programs arose from security systems like CCTV and, therefore, that the dividing line between "mass media and high technology" is entirely artificial (2010:32). Something similar can be said about capital's media; for example, the science and technology of radio that has been applied to entertainment is also used to make the circulation of commodities in the supply chain trackable and visible using radio technology like radio-frequency identification chips (RFID).

That I posit capital's media as a phenomenon of circulation and as something that function for the circulation process, means that the Marxist component of this theoretical framework is focused on the sphere and process of circulation. The dissertation therefore primarily relies on Marx's elaboration of circulation, which is found in the first six chapters of *Capital Vol. 1*, the entirety of *Capital Vol. 2*, and various sections of *Grundrisse*. The point of departure for the category and theory of capital's media is, in other words, how Marx analyzes capital as a process. As he argues, capital does not just comprise class relations but is also "a movement, a circulatory process through different stages... it can only be grasped as a movement... not as a static thing" (Marx 1978:208). That circulation refers both to the *formal* movement whereby capital changes form from commodity into money and back again, and also to the *material* (physical) movement of

matter in time and space, means that circulation can be analyzed in terms of formal and material movements.

In this dissertation, I posit that capital moves by way of its media. The primary research questions this dissertation poses is: how does capital move? Answering this question, however, requires answers to several other questions, such as: Why is capital a movement? How does Marx define movement? What is the relationship between movement and the economic forms of capital? How is capital mobilized? Where does capital move? How is capital's movement organized in time and space? More specifically, considering I argue that capital's media materially mediate the formal movement of capital: how does this material mediation occur? To what does material mediation refer?

It is in answering these questions that it is necessary to turn to new materialist media theory and Virilio's dromology. Broadly, new materialist philosophy explores the agency of non-humans and the material world, adopting a perspective which decenters the human subject (Tompkins 2016). New materialist media theory, as a subset of this broader field tradition, is concerned with "things and materiality, as well as medium-specificity" and is an approach that elaborates the "material ontologies of and challenges to the storage, distribution and processing of communication events" (Parikka 2012:63).¹⁵ Following Parker (1977; 1981), Kjøsén (2013), and Manzerolle and Kjøsén (2012; 2015), I posit that communication refers broadly to the circulation process of capital.

A conceptual bridge with which to connect new materialism with Marx's value theory is found in Parker's (1977; 1981) earlier attempt at a synthesis between Marx and Innis. Parker argues that Innis' post-staples work concerns "the economics of communication" that he defines as the "study of the determinants of the structure of spatial and temporal relations within and between open economic systems" (1981:129). Open economic

¹⁵ Kittler (1999; 2010) and Wolfgang Ernst (2013) are perhaps the most well-known theorists that fall under the new materialist label. Their approaches have also been referred to as "hardware theory" due to their close attention to the engineering and science of technological media (Parikka 2012:64).

systems exist and are reproduced in time and space, and require what Parker refers to as “anti-entropic” or communicative activities for their reproduction (1981:130).¹⁶ The capitalist mode of production is such an open economic system considering that capital is reproduced as a process in time and space. According to Parker five basic communicative activities determine an open economic system’s reproduction, although I focus on only three of them:

first, transportation through time between spatially separated centers of material goods or commodities (including “trade flows”); second, as a special case of the first category, translation through time of material goods or commodities, without a change in spatial location (including “storage activities” and “inventory management”)... fourth, transmission of property claims to real resources (including “monetary transfers” and “capital flow”)... (1981:130-1).¹⁷

I posit that anti-entropic activities can be understood as the “communication events” that new materialism elaborates and challenges, but importantly that they also refer to how the circulation process is mediated by capital’s media.

By extension, the “anti-entropic activities” refer to the media functions that Canadian-German media theory have elaborated as transfer, storage, and processing. Whereas Innis (2007) first identified time-biased storage media and space-biased transfer media as a choice in cultural communication, Kittler added the function of processing based on the computer and his analysis of the possibility of manipulating the flow of time when a temporal data stream is recorded on a storage medium (1999; 2010). In other words, what I take from Canadian-German media theory to fill the critical gap of media in Marx’s theory, is limited to these media functions and how they are articulated in terms of overcoming, bridging or organizing space and time. In chapter six, I bring these functions to bear on how they overcome or bridge the barriers to capital in the sphere of circulation.

¹⁶ I discuss why they are anti-entropic in chapter six.

¹⁷ The two remaining anti-entropic activities are “transportation of persons between spatially separated locations” and “transmission of information and power-based instructions over time and space” (Parker 1981:130-1).

Although Virilio (1991; 1997) does not belong to the tradition started by Innis, I consider his science and logic of speed (dromology) to be the most sophisticated articulation of the function of transfer due to elaborating the relationship between infrastructure and vehicles.

A new materialist analysis of circulation concerns itself with how the circulation process of capital is materially mediated by the media functions of transfer, storage, and processing. In turn, this requires a consideration of what Innis (2007:26-7; Watson 2008:xviii-xix) referred to as the material characteristics of specific media and how they operate. Paying attention to material characteristics could be labelled as *dinglich* (thing-like) by the orthodox Marxist even though it is a necessary step to identify how certain things functions as capital's media of transfer, storage, and processing. Although Kittler discusses the respective titular media in great detail in terms of their science and engineering in *Gramophone, Film, Typewriter* and *Optical Media*, he is always more interested in media functions rather than with any particular technology. While recognizing that "all technological media either store, transmit or process signals," Kittler places the "general principles of... storage, transmission, and processing above their various realizations" (2010:25-6). Despite his focus on function over material realization, Kittler, and by extension new materialist media theory, cannot, therefore, be blamed for being *dinglich*.¹⁸

Method: a circulationist reading of *Capital*

In accord with Marx's method of analysis by a dialectical shuttle between the abstract and the concrete, this dissertation has two components to its methodology: a theoretical orientation and a set of empirical case studies.

¹⁸ While there are some similarities between the approaches of Marx and Kittler, such as focusing on function rather than things, the latter German would likely disagree with my approach considering I subject media to the dialectic of form and matter whereas Kittler (2009) rejects that in favour of an ontology based on the trinity of commands, addresses, and data.

Theoretical orientation

The theoretical orientation involves a circulationist reading of *Grundrisse* and the volumes of *Capital*. The term “circulationist” has been derogatorily applied to Marxists like I. I. Rubin and proponents of *Neue Marx-Lektüre* (new Marx reading) as an accusation of advancing “a circulation theory of value, and thus of approaching value by placing emphasis on a supposedly negligible aspect” (Heinrich 2012:54).¹⁹ Despite the negative connotations of the term, I embrace “circulationist” and use it to refer to a particular new Marx reading that sets in relief not only the process and sphere of circulation, but also associated categories, concepts, and phenomena. A circulationist reading means adopting circulation as a point of view. But what is a circulation point of view? What is a point of view in Marx’s political economy? What are the implications of adopting such a viewpoint?

I derive the circulationist point of view from the two-fold character or liminal status of transportation and the means of communication in Marx’s value theory. Although Marx considers transportation a branch of production, in *Capital Vol. 2* he argues that the production process of this branch is “distinguished by its appearance as the continuation of a production process *within the circulation process and for the circulation process*” (1978:229, emphasis added). I argue that the point of view of circulation is encapsulated in the phrase “*within the circulation process and for the circulation process*” and that it is from this point of view that things that would normally be thought of as machinery can be understood as capital’s media.

According to Bertell Ollman (2003:99-109), point of view or “vantage point” is one of Marx’s methods of abstraction. Throughout *Capital*, Marx adopts many positions that appear to be contradictory and introduces these positions by the phrase “from the point of view of...” Ollman argues that these contradictory positions are a result of Marx adopting

¹⁹ For critiques that consider Rubin and value-form analysis as circulationist, see De Angelis (1995), Kicillof and Starosta (2007; 2008), Carchedi (2009), and Starosta (2015). A circulation theory of value would refer to a theory positing that value is created during exchange as, for example, neo-classical economics claim.

different points of view so that the “same relation is being viewed from different sides, or the same process from its different moments” (2003:100). For example, the wage-relation can be considered from the side of both capital and labour, and capital can be viewed from both a production and circulation vantage point. Ollman explains that a

vantage point sets up a perspective that colors everything that falls into it, establishing order, hierarchy, and priorities, distributing values, meanings, degrees of relevance, and asserting a distinctive coherence between the parts. *Within a given perspective, some processes and connections will appear large, some obvious, some important; others will appear small, insignificant, and irrelevant; and some will even be invisible* (2003:100, emphasis added).²⁰

The vantage point of circulation is, therefore, one in which categories associated with circulation appear large, while those associated with the sphere and process of production are less relevant.

An implication of the circulation point of view and positioning of media as a phenomenon of circulation is that explaining how capital’s media function must rely on concepts and categories that belong to circulation. In addition to the concepts I identified in the literature review, circulation-based categories that I rely on are the value form, contradiction, circulation time, and the velocity of capital.²¹ Moreover, there are several phenomena Marx discusses in the context of the circulation process of capital that indicate either the particular functioning or examples of capital’s media. The most salient include storage, stock formation, transportation, packing and sorting, and “measures of precaution” that must be taken when transporting use-values that are more or less fragile, perishable or explosive (Marx 1978:228). Conversely, categories belonging to

²⁰ The other two methods of abstraction, according to Ollman, are “extension” (2003:73-86) and “level of generality” (2003:86-99).

²¹ While costs of circulation are an important category for analyzing the circulation process, it will unfortunately not be applied in this dissertation because it is primarily focusing on capital’s qualitative rather than quantitative movements. Consequently, I also do not focus on book-keeping even though Marx discusses this in *Capital Vol. 2*.

production, such as labour, exploitation, class struggle, and machinery recede into the background.

The circulationist reading of *Capital* is a variation of the philologically oriented *Neue Marx-Lektüre*. This new reading of Marx emerged in the late 1960s West Germany as a specific response to Western Marxism's interpretation of Marx but draws its lineage back to early heterodox Marxists, in particular, Isaak Illich Rubin ([1928]1973), and Evgeny B. Pashukanis ([1929]1989).²² *Neue Marx-Lektüre* was first articulated by the Adorno-students Hans-Georg Backhaus (1997), Helmut Reichelt (1970), and Alfred Schmidt (2014), but today Michael Heinrich (2012), Ingo Elbe (2013), Dieter Wolf (2002), and Frank Engster (2014) are some of the most notable proponents.²³ *Neue Marx-Lektüre* abandons some of the central topics of Western Marxism, including the substantialist theory of value; manipulative-instrumental conceptions of the state; and labour-movement-centric interpretations of *Capital* (Ramsay 2009; Elbe 2013).²⁴ Instead, the focus is on (economic) form-determination as the original object of capital, the dialectical presentation of the form of value, and the connection between the three volumes of *Capital* and *Grundrisse*.

The main contribution of value-form analysis is its critique of so-called substantialist theories of value that view value as a physical substance found in the individual commodity that can be traced back to the physical expenditure of muscle and brainpower

²² *Neue Marx-Lektüre* (new Marx reading) is also referred to as value-form analysis due to the close attention it pays to Marx's development of the value form, i.e. why he argues that labour assumes the money form in the capitalist mode of production. Western Marxism refers to the official communist parties and thus to Marxism-Leninism of various stripes, including Trotskyism and Stalinism.

²³ By casting a wider net, *Neue Marx Lektüre* also includes people like C. J. Arthur, Werner Bonefeld, Patrick Murray, Riccardo Bellofiore, and others involved with *Open Marxism* (see Bonefeld, Gunn and Psychopedis 1992a; 1992b; Bonefeld, Holloway, and Psychopedis 1995). Unfortunately, most of the central texts of *Neue Marx-Lektüre*, including those of Backhaus and Reichelt, have yet to be translated into English. Backhaus (1997), Reichelt (1970), and several other texts by value-form theorists are, however, in the process of being translated by Brill.

²⁴ Examples of labour-movement-centric interpretations include Leninism, autonomism, and variants of left communism.

by living labourers (see e.g. Haug 1989; Kicillof and Starosta 2007; 2008; Carchedi 2009). Against this view, *Neue Marx-Lektüre* points out that because value is an abstraction of the social relations of production, it is a *social* substance that can only appear in its form during the moment of exchange. As Reichelt explains, value is the “movement” whereby the commodity transforms into money (2005:39, 46). Anders Ramsay clarifies that value “does not arise in exchange without a labour process, but without exchange, concrete labour would never be reduced to abstract labour either, and thus, no value would emerge” (2009:n.p.).

It is this recognition of circulation and its antithetical relationship to production that makes *Neue Marx-Lektüre* attractive as a basis for a circulationist reading of Marx. That value is a social substance makes it an imperative to move commodities and money together in time and space. In other words, capital mobilizes things and people, gives them a reason to move, and choreographs this movement in time and space. I argue that this mobilization suggests another focus of new Marx reading, namely form-determination.

Marx conceived of capitalist domination as “anonymous, objectively mediated and having a life of its own” rather than any instrumental rule by the state (Elbe 2013:n.p.). What differentiates capitalism from other modes of production is that exploitation is impersonal due to being mediated by the buying and selling of commodities, i.e. the commodity fetish (Bidet 2008:374; Heinrich 2012:47). Marx explains this impersonal domination with value theory in general, but in particular with form-determination.²⁵ With this concept, Marx argues that the way in which things are treated in capitalism is determined by the economic form in which they appear. While a chair is a use-value to sit on, this useful effect cannot be enjoyed until it has been sold and bought as a commodity; that the commodity’s function is to be sold thus determines what can be done with the chair. These functions are executed by social individuals, which means that they carry out

²⁵ Form-determination is short for the more correct “economic form-determination” (*ökonomische Formbestimmung*).

the structural necessities of reproducing capital. In this dissertation, I extend this form-determination argument to (1) include how things, people, and information are determined to move in space and time; and (2) how the things I argue function as capital's media are determined to materially mediate the circulation process of capital as moments of transfer, storage, and processing.

My final comment on *Neue Marx-Lektüre* concerns the close attention they pay to how Marx develops economic categories because I develop the category of "capital's media" in a similar manner. Marx attacked what he saw as the fetishism peculiar to bourgeois economics that "transforms the social, economic character that things are stamped with in the process of social production into a natural character, arising from the material nature of these things" (1978:303). For Marx, the point is not to come up with "a set of definitions under which things are to be subsumed. *It is rather definitive functions that are expressed in specific categories*" (1978:303, emphasis added).²⁶ In this dissertation, I argue that it is the functions of transfer, storage, and processing that are expressed in the category of capital's media and form the basis of capital's media ontology. I am effectively "Frankensteining" the category of capital's media onto Marx's system of categories; as if I am adding an extra limb or organ that did not evolve directly from or does not necessarily perfectly fit the organism to which it is attached, but is nevertheless functional.

The concept and theory of capital's media I propose in this dissertation is the conceptual but complementary opposite to Marx's conceptualization of machinery in production. Capital's media can be understood as a conceptualization of machines (or fixed capital or technology) from the point of view of circulation. Fixed capital splits into machinery (production) and media (circulation), but between them, there is a liminal blurring; the distinction is analytical because the same piece of fixed capital (such as a container ship)

²⁶ Arguably, coming up with a set of definitions under which things are subsumed is what Fuchs did with his media typology.

can function simultaneously as both a machine (for the owner-operator) and a medium. Hence the need for a circulationist point of view.

Empirical case studies

The circulationist reading herein informed the selection of case studies; because the sphere of circulation includes the material domain of logistics and supply chains, the case studies are drawn from this domain. While I discuss logistics in more depth later in this dissertation, this art arguably concerns the circulation of capital. As Brett Neilson argues, “what Marx described as the mediation of social relations ‘though things’ has become the thriving management science of logistics” (2014:84). More specifically, logistics refers to “all the activities required to move product and information to, from and between members of a supply chain” (Bowersocks et. al. 2012:v; Branch 2009:1). In the business logistics literature, these activities include: (a) purchasing (sourcing); (b) forecasting; (c) inventory management and warehousing; (d) transportation (distribution); (f) location; (g) scheduling (coordination); and (h) materials handling and packaging (Bloomberg, LeMay and Hanna 2002; Hugos 2003; Boyer, Frohlich and Hult 2005; Enarsson 2006; Li 2007; Bonacich and Wilson 2008; Lai and Cheng 2009; Branch 2009; Blanchard 2010; Christopher 2011; Sheffi 2012; Bowersocks et al. 2012).²⁷

These activities were used as a guide with which to select the case studies I discuss in chapters three to five in this dissertation. The rationale behind this is that logistical activities are typically dependent on technology to be carried out. For example, the activity of forecasting relies on the collection of information about what is bought, when, and at what price, which, as I discuss in chapter five, occurs at the point of sale through scanning barcodes and swiping payment and/or loyalty cards. As I discuss in chapter four, inventory management is dependent on distribution centers (warehouses) and their interior technology of conveyors and sensors or automated storage and retrieval systems to either directly route the commodity to its next location or store it at the facility.

²⁷ This list is not exhaustive, but represents the current breakdown of logistic activities that appear to be common to most texts on logistics of supply chain management.

Moreover, transportation is, of course, dependent on various vehicles (train, truck, ship, and airplane) and infrastructure of highways, railways, and various ports. In chapter three I discuss the shipping container and intermodal transportation as a particular example of capital's transfer media.

Chapter breakdowns

This dissertation is divided into three parts and six chapters. The chapters follow the method of presentation of Marx's political economy, which he described as rising from the abstract to the concrete and back again (1973:100-8). In other words, each chapter discusses capital's media more and more concretely. It is through this method of presentation that the category of capital's media is progressively filled with content. In addition, a red thread running through this dissertation's chapters is a more and more granular discussion of the commodity's movement to the market and eventual conversion into money.

Part one includes chapters one and two and focuses on movement and circulation. The research questions I directly address are: How does capital move? Why does capital move? Where does capital move? With what means does capital move? In chapter one, I discuss the circulation process of capital in terms of its division into formal and material movements. More specifically, the chapter discusses the peculiar ontology of value, the importance of form-determination and the commodity's internal contradiction in understanding how capital mobilizes things and people to carry out economic functions. The chapter identifies the commodity's guardian as the first logical example of capital's media in *Capital* because this guardian materially mediates value's circulation. The chapter argues that the commodity's internal contradiction can be understood as the reason behind why things, people, and information move in the capitalist mode of production.

Chapter two discusses how capital moves in the sense of the routes or specific paths it must follow. It thus addresses the question of "where does capital move?" With reference to the spatial arrangement of production into geographically stretched supply chains, the chapter argues that capital must follow the route set by specific supply chains because it

is form-determined by the circuit of capital. By focusing on where capital moves, the chapter also identifies the position of capital's media in the social process of production as connecting different points of production via circulation processes. In addition, the chapter discusses the formal position of capital's media in Marx's system of categories with reference to Marx wrote about the means of communication and transport. Based on this discussion, the chapter argues that capital's media belong to the "general conditions of production" and is positioned as the circulatory counterpart to machinery (fixed capital) in production.

Part two of the dissertation includes three chapters in which I discuss examples of things that function as capital's media and thus how capital moves materially. In this part I focus on the material characteristics of these objects and how they operate to mediate the circulation of capital materially. The individual chapters demonstrate how capital's media change and develop to become "adequate" to the mode of production. In chapter three, I discuss the standard shipping container and intermodal transportation as the dominant means with which to transport commodity capital and how it developed from the breakbulk method of shipping. Chapter four concerns the transformation of the warehouse into the distribution center and how it mediates capital's movement by routing it on to the next destination in the supply chain. With reference to Walmart, the chapter discusses the distribution center both in terms of its internal operations and as part of a larger network of distributing centers. Chapter five turns to media that are located at the point of sale (POS) and discusses POS-systems—a remediation of the cash register—and payment systems. In this chapter, the focus is on how POS-systems through scanning barcodes collect information about what is bought in order to manage and position inventory in the supply chain. The chapter also discusses the only example of a medium for money capital dealt with in this dissertation: VISA's payment system for debit and credit. The discussion of this particular payment system is centered on how money is repatriated to the capitalist after commodities have been sold.

Part three consists of the sixth and final chapter of this dissertation. In this chapter, I develop the general and particular functions that are expressed in the category of capital's media. Specifically, I argue that media's functions of transfer, storage, and processing

can be understood as overcoming the barriers of space, time, use-value (need), use-value (perishability), and equivalents. Chapter six juxtaposes the media functions as elaborated by Canadian-German media theory with Marx's value theory. In addition, the concluding chapter discusses the case studies from part two in terms of how they function as capital's transfer, storage, or processing media.

A note on labour and human beings

An implication of adopting a circulationist reading is that central categories in Marx's value theory related to production—labour, exploitation, and class struggle—are mostly eclipsed in this dissertation. A circulationist reading is a partial reading of Marx's political economy and must necessarily present capital within the narrow confines of the sphere of circulation, which is a deliberate choice in order to set media as a phenomenon of circulation in relief.²⁸ But what does this eclipsing mean for how I treat living human labourers, the working class, and its struggles? What assumptions am I making by bracketing these categories and processes?

In *Optical Media*, Kittler argued that McLuhan with his understanding of media as the extensions of man, “attempted to think about technologies in terms of bodies rather than the other way around” (2010:29). One implication of the circulation point of view is to treat the bodies of living labourers in terms of technologies when it comes to analyzing the circulation process of capital. Consequently, if the living human labourer transports

²⁸ Another reason for eliding labour in my research is that I find research questions that asks about the conditions of labour or the class struggle in [your choice of industry] unfortunately tend to lead to predictable answers. Since the 1970s turn to a flexible accumulation regime, working conditions have in general worsened, real wages have fallen, employment is increasingly precarious, manufacturing takes place in the global south by feminized and racialized others, and the working class is still decomposed and unable to mount any real struggle against capital and its representatives (see e.g. Harvey 1990; Dyer-Witford 1999; 2015; Collins 2003; Brooks 2015). The same story holds true in logistics, i.e. the branch of production to which most of capital's media belong (Bonacich and Wilson 2008; Cowen 2014a). It is beyond the purpose of this dissertation to analyze the conditions of labour and the current state of the class struggle. There are, however, several excellent academic texts on precisely this topic (Collins 2003; Bonacich and Wilson 2008; Toscano 2011; 2014; Bernes 2013; Cowen 2014a; D'eraimo 2015; Brooks 2015) and several activist and trade union initiatives that report on and analyze the state of the class struggle in the industry, including the Logistical Worlds project (<http://logisticalworlds.org/>), Warehouse Workers United (www.warehouseworkersunited.org), Angry Workers' World (<https://angryworkersworld.wordpress.com>), and the Empire Logistics project (www.empirelogistics.org).

commodities to the market by carrying them on her back, she is a vehicle—a metabolic medium of transfer—as much as a truck or train. More precisely, by doing so, the living human labourer is stamped with the category of medium. This ontological reduction is, however, only valid when it is the human being alone that carries out the media function. How do I treat the living labourer if she is a truck driver, crane operator or a picker in a distribution center?

In *Understanding Media*, McLuhan argued that in relation to media change, man has become “the sex organs of the machine world, as is the bee of the plant world, enabling it to fecundate and to evolve ever new forms” (1994:56). Living labourers are not the sex organs for capital’s media, but rather their thinking organs. I take a cue from Marx’s argument that by personifying an economic category, individuals give a consciousness and will to the things that are the content of that category (1976:254). A truck does not usually drive itself; order picking in a warehouse is not necessarily automated; and the cranes that discharge and reload container ships require operators. From the vantage point of circulation, these drivers, pickers, and operators, merely give the truck, warehouse, and crane a consciousness and will. In addition, by focusing on circulation, the labour that I discuss in this dissertation is treated as if it is unproductive of surplus-value and thus that it all behaves like the “work of combustion,” i.e. as if it functions to only facilitate the conversion of commodities into money (Marx 1978:208).

By treating living labourers more as objects than subjects, I also have to bracket working class resistance and class struggle. By doing that, I am not arguing that the working class is incapable of resisting the domination of capital or struggling against it; far from it, class struggle is a fact of life of the capitalist mode of production and its engine. Without class struggle, there is no exploitation, extraction of surplus-value, and capital accumulation, which also means there would be no need for circulation. Due to adopting the circulation point of view, I make the assumption, as I have done before, that “production, exploitation and the class struggle runs as if on autopilot and thus that capital is accumulated without interruption” (Kjøsen 2013:4). I assume that capitalism proceeds as normal with all its strikes, police and military violence, riots, victories and

defeats, economic crises, environmental degradation, occupations, trade union betrayals, and blood, sweat, and tears.

The danger of adopting the circulation point of view and of bracketing some of the central categories of Marx's political economy is that I risk, as Moishe Postone (1973) did in *Time, Labour and Social Domination*, of embedding human social action within the framework of capital's economic forms and completely rendering it as an attribute of things. As Werner Bonefeld argues, Postone forgets that "[h]owever much capital appears to have autonomised itself, it presupposes human social relations as its substance" (Bonefeld 2004:117). While I am sympathetic to Postone and the broader *Wertkritik* tradition's attack on the dogma of productivity *über alles* (see Krisis 1999), the working class is not a phenomenon internal to capital; it is because human social relations are the substance of capital that the working class exists as capital's negative potential.²⁹

Despite making the assumption that the substance of capital is human social relations, the way in which I present my analysis could be correctly accused of veering towards a fetishism of capital, i.e. portraying capital as a relation between things (Marx 1981:829). This method of presentation is, however, based on how Marx presented his discussion of the circulation process in *Capital Vol. 2*, where there is little reference to the activity of human beings precisely because the sphere of circulation *is* structured as a relation between things.

²⁹ Indeed, labour must exist as the negativity of capital otherwise exploitation would not be possible. If labour existed within capital, the latter would have to affirm the creativity of human beings rather than negatively exploit it. *Wertkritik* is translated as "value critique" or the "critique of value" and is associated with the German group *Krisis* and its splinter group *Exit!*, and with names such as Ernst Lohoff, Robert Kurz and Norbert Trenkle. For an introduction to *Wertkritik* see Larsen, Nilges, Robison and Brown (2014).

Part 1: Movement and Circulation

1 “Capital is a movement”

“Capitalism knows no static condition.”

— Pavel. V. Maksakovsky, *The Capitalist Cycle*, 20.

The famine of 1865 and 1866 that ravaged the Indian state of Orissa³⁰ under British colonial rule was one of the most severe of that century with a total mortality estimated at 1,364,539; about a quarter of the total population. Robert Gascoyne-Cecil, the Secretary of State for India “wondered why in spite of the applications of the principles of political economy, people were dying in thousands when famines occurred” (Ambirajan 1978:80). Colonial famine policy strictly followed bourgeois political economy’s advice of free trade and non-interference in the market (Ambirajan 1978:76, 80). The orthodox argument that markets can cure famines was first proposed by Adam Smith ([1776] 1986), enthusiastically defended by Malthus, and accepted as reality by English colonial administrators. T. E. Ravenshaw, the commissioner of the Cuttack division, who had complete faith in the laws of supply and demand, believed that lack of food in Orissa would lead to higher prices, and therefore that food would move into the state to take advantage of the favourable market conditions. He expressed disappointment when private traders did not move food into the state because “under all ordinary rules of political economy the urgent demand for grain in the Cuttack division *ought to have created* a supply from other and more favoured parts” (in Ambirajan 1978:76). Similarly, in 1912 when a famine was developing in Gujerat, “the Governor of Bombay turned down a proposal for moving food into... affected areas by asserting the advisability of leaving such matters to the market mechanism, quoting ‘the celebrated author of the *Wealth of Nations*’” (Sen 1981:160). The accepted policy was that the ordinary rules of political economy would provide real relief in cases of widespread scarcity. The ordinary rules of political economy are, however, as Marx argued, based on appearances. Precisely

³⁰ Orissa, today called Odisha, was an Indian east coast state on the Bay of Bengal.

the opposite of what these ordinary rules stipulate can happen during times of famine: food moves out of famine-stricken areas instead of flooding in because people in famine struck areas cannot back up their need with money. This movement of food had been observed during the Irish famine of the 1840s, the Bengal famine in 1873-74, among other Indian famines, and in the province of Wollo during the 1973 Ethiopian famine (Sen 1981:93-96, 161).

US Patent No. 8615473 for a “Method and System for Anticipatory Package Shipping” was awarded to the online retailer Amazon on Christmas Eve 2013 (Spiegel et. al. 2013). In essence, the patent describes how the retailer may build a system for shipping packages of commodities to potential buyers before they have placed an order. If an algorithm detects a high probability that someone in a general geographical area will place an order for a particular commodity, then it will decide to ship it to that area without specifying an address; if an order is placed for the commodity in transit, the package will be rerouted to the address associated with the order. If no equivalent for the commodity actually appears, it may be offered at a discount to “induce a sale”, given as a “gift” in exchange for potential “customer goodwill” or be rerouted, potentially multiple times, to other geographical areas which Amazon’s algorithm has identified as likely having customers. At any time, numerous such packages may be simultaneously moving through Amazon’s supply chain (Spiegel et. al 2013).

I draw attention to these divergent examples because they are related in one important aspect, namely the peculiar way in which things of social need move in the capitalist mode of production. Marx argues that “capital is a movement, and not a static thing” (1978:185). He conceives of capital as an abstract, autonomous process that passes through the economic forms of commodity, money, and a valorization process. This abstract process is, however, perpetuated by the movement of the matter capital is invested in when assuming a particular economic guise. What is the relationship between

the movement of abstractions and matter? How does capital move as a material process?
What is circulation?

In this dissertation, I argue that capital moves via its media. Capital's media function to mediate materially the abstract process that is capital. More specifically, they provide logistical support for capital's movement through the space-time of the sphere of circulation. Capital's media are, therefore, as Marx (1973:533) argued with reference to the means of communication and transport, "the physical conditions of circulation," i.e. the material conditions for the transformation of commodities into money and back again. This definition is the result of my circulationist reading of Marx's value theory that started with the research question 'how does capital move?' It is necessary to consider why Marx conceives of capital as a movement and not a static thing. This focus on movement is also needed to explain what Marx means by circulation, which can be understood as a combination of a "formal movement" of abstractions and the material movement of things, people, and information.

Helmut Reichelt argues that Marx developed a language that corresponded to "the specificity of its subject matter" (2005:46). Because capital is a universal concept that exists, in contradiction to itself, as a succession of particular economic abstractions, it cannot be defined as something static or in terms of a material substance. Such an existence can only be described in terms of movement (Reichelt 2005:39). Marx's vocabulary, therefore, includes and gives salience to words like "motion," "circulation," "process," "proceed," "speed," and "acceleration," and also their antonyms, like "idle," "static", and "slowness."

The *Grundrisse* and the three volumes of *Das Kapital* are replete with this language. Marx writes that value is a "self-moving substance" (1976:256) and is a "movement made by things" (1976:167). Capital is a "moving contradiction" (Marx 1973:705) that "proceeds in time and space", but is "negated" as capital if does not move (Marx 1976:516). In order to move, capital relies on the means of communication and transport, which increases capital's velocity by their "annihilation of space by time" (Marx 1973:524). Marx refers to the metamorphosis of value (and capital) from commodity into

money and back again as a “formal movement,” but notes that although this formal movement “may require a motion of the products in space, their *real movement* from one location to another”, circulation can “take place without their physical movement” (1978:226). For Marx, movement is something that is spatial, temporal, qualitative, quantitative, slow or fast, real (material), and formal.

This chapter starts with a close reading of one of the most important accounts of the motion of capital, which is found in the peculiar opening to the second chapter of *Capital Vol. I* where he states that commodities must “go to market” in order to perform exchanges. The interpretation focuses on Marx’s concept of form-determination and his treatment of individuals as personifications of economic categories. The material movement of the commodity going to market is a logically necessary *mediating function* of circulation, and I argue that people and things—including what I later term capital’s media—are caught up in the “logic” behind this function. This logic is tied to the commodity’s immanent contradiction between use-value and value (or concrete and abstract labour), and the externalization in commodities and money that gives this immanent contradiction room in which to move in space and time. I conclude the chapter by connecting the analysis of why value is a movement to capital’s media, by arguing that because the personification of the commodity carries out this function, s/he can be considered the first logical example of capital’s media we encounter in the volumes of *Capital*.

1.1 “Go to market”

Marx opens the Chapter Two of *Capital Vol. I* with a passage that at first appears somewhat weird:

Commodities cannot themselves go to market and perform exchanges in their own right. We must, therefore, have recourse to their guardians, who are the possessors of commodities. Commodities are things, and therefore lack the power to resist man. If they are unwilling, he can use force; in other words, he can take possession of them. In order that these objects may enter into relation with each other, as commodities, their guardians must place themselves in relation to one another as persons whose will resides in those objects... Here the persons exist for one another merely as representatives, hence owners, of commodities. As we proceed to develop

our investigation, we shall find, in general, that the characters who appear on the economic stage are merely personifications of economic relations; it is as bearers of these economic relations that they come into contact with each other (1976:178-9).³¹

In isolation, the above passage is strange because Marx seems to state the obvious. *Of course*, commodities cannot go to market by themselves; *of course*, they must go to market so they can be exchanged. Even more peculiar, however, is how the relationship between commodities and their guardians are presented. The commodity's trajectory and function come prior to Man even though he appears to be master over the commodity given that it cannot resist him. But as Marx argues, the commodities' guardians place themselves in relation to each other as persons whose wills resides in their objects, and that they exist for each other only as the representatives, the personifications, of the commodity; the only reason that they come into contact with each other is through their commodities.³² How can the human individual be a mere personification of the commodity? In this passage, Marx seemingly affirms the master-slave relationship between subject and object by arguing that the commodity lacks the power to resist the force of Man, and is dependent on him to "go to market" and "perform exchanges." Although the guardian appears to be the master over the object, is this really the case?

Passages in *Capital Vol. 1*, like this "logistical" opening to Chapter Two, cannot be cherry-picked and read in isolation from what precede them or indeed from the entire book. *Capital Vol. 1* is a complete system, a totality with a narrative presented as a dialectical development (and critique of) economic categories. Marx presents categories

³¹ From now on, I refer to the first and second chapters of *Capital Vol. 1* as Chapter One and Chapter Two.

³² I deliberately omitted a part of the quote that discusses the juridical relation between the two commodity owners. After the ellipsis, the following is stated: "and must behave in such a way that each does not appropriate the commodity of the other, and alienate his own except through an act to which both parties consent. The guardians must therefore recognize each other as owners of private property. This juridical relation, whose form is the contract, whether as part of a developed legal system or not, is a relation of two wills which mirrors the economic relation." The principle of equivalent exchange is thus guaranteed by a legal relation that mirrors the economic relation. This passage is therefore important for Pashukanis' (1989:112-4) Marxist legal theory and the German state-derivation debate (that attempted to derive the political form of the state from the value form) (see Altvater and Hoffman 1990).

as they fit into this total system; the dialectical presentation of these categories describes the functional relationship between the categories in this particular system, and as such, describes the inter-relationship of processes (e.g. production and circulation) in the capitalist mode of production. The argument of *Capital* is that this complex of processes revolves around social relations that work behind the backs of human individuals who only appear to be subjects with agency. In reality, both subject position and behaviour are determined by the economic forms that a social individual may personify.³³ Value occupies the place of agency.

The opening of Chapter Two, therefore, makes sense only when read in relation to its preceding chapter and interpreted according to what *Neue Marx-Lektüre* considers the original object of *Capital Vol. 1* to be, namely “form-determination” (Reichelt 1982; Bidet 2008; Elbe 2013). The reference to the commodity’s guardian is the first reference to a (human) subject and its activity in the book. There is a dearth of people or any identifiable human agents in Chapter One; here, Marx merely observes the exchange of commodities and uses the passive voice to describe their intercourse. He waits until Chapter Two to introduce exchange as an activity carried out by people at the market. The peculiarity of the passage thus comes from its form-analytical relationship to the preceding chapter’s analysis of the commodity, value, and the value form.

In the above passage, Marx intentionally puts the cart before the horse, or more precisely a thing in the social form of the commodity before its legal human owner. In other words, the passage describes a fetishistic relationship in which the relation between things is primary. This order mirrors the overall dialectical presentation in *Capital Vol. 1*, in which the economic form is always analysed and presented prior to the activity of individuals. The determinant of the commodity—exchange at the market—is prior to the activity of the guardian who performs the exchange and before that also moves the commodity to the market. The commodity’s function is to be sold—specifically, as

³³ Marx uses the terms economic forms, economic categories, economic abstractions, and social forms interchangeably. Throughout the dissertation I do the same.

Marx's development of the value-form demonstrates, it must be compared to the universal equivalent, i.e. money (1976:138-163). By executing this function, Man is reduced to a mere relay for carrying out a structural necessity of capital and in the capitalist mode of production.

Exchange requires that sensuous-concrete commodities enter into relations with one another, which forces their guardians—commodity-owners—to confront one another. The relations between things precede and therefore mediate the relation between persons. Put differently, because of the fetish that attaches itself to commodities, relations between people appear as a social relation of things. The reason why commodity-owners must confront each other is because their respective commodities require it for intercourse and, fundamentally, for value to be value. Marx indicates this with the statement that the guardians “place themselves in relation to one another as persons whose will reside in those objects”, and that this relation of two wills is “determined by the economic relation”. The logic or reason for economic activity, in this case, exchange and movement to the market, does not come from a rational, individual *homo economicus* but rather emanates from the social form of the commodity that gives things a determined social function.³⁴ That the phrase “go to market” is also presented prior to the appearance of the “guardian” as the agent that carries out this activity is significant for the development of a theory of capital's media because it can be understood as a material mediation of the formal necessity of exchanging the commodity for money.

1.2 Form-determination

What is form-determination? In order to answer this question, it is necessary to understand that Marx makes a distinction between the ‘natural form’ of a thing and its ‘social form’ (Heinrich 2012:40). The relationship between these two forms is that the former is the content of the latter. Natural form—a term Marx preferred over use-value in the first German edition of *Das Kapital* (1867)—refers to a thing's material composition

³⁴ As Nick Dyer-Witheford suggested to an earlier draft of this chapter, this means that the content of *homo economicus* is this abrogation of will to things.

and sensuous characteristics, such as a chair made out of wood, with the colour green, a straight back and situated in a particular place. Natural form, therefore, refers to the specific characteristic a thing has irrespective of the society it exists in; they, therefore “constitute the material content of wealth, whatever its social form may be” (Marx 1976:126).³⁵ Social form, on the other hand, refers to the characteristics of things that do not belong to them as natural things but comes from the economic structure of the society in which they exist.

When Marx argues that use-values are “the material bearers of... exchange-value” in capitalist societies, he is making an argument about social form (Marx 1976:126). Something that has both a use-value and an exchange-value has the social form of “commodity”; that a chair is a commodity thus means it is something that is exchanged and possesses an exchange-value, and therefore belongs to a society in which almost everything produced is exchanged (Heinrich 2012:40-1). Given that social forms are unique to a given society or mode of production, there exist other social forms. In societies of “total prestation”, the chair’s social form could be a gift that gives the chair the power to create social bonds through a system of reciprocity that engages the honour of both giver and recipient (Malinowski 1922; Mauss 1990; Godelier 1999). In feudal societies, the social form in which things appeared was the feudal rent or tithe. The social form in which things would appear in a communist mode of production could be the “common” as Nick Dyer-Witheford (2007) has suggested.

Form-determination is at the core of Marx’s value theory (Reichelt 1982; Bidet 2008). Michael Heinrich argues that with “value theory Marx seeks to uncover a specific social structure that individuals *must* conform to, *regardless of what they think*” (2012:46). The activity of individuals, such as going to market and buying and selling, is determined by the social context. As such, value is an impersonal relation of domination that acts through “thingified” economic abstractions.

³⁵ Material wealth should be understood in relation to need or use, such as one coat keeping one person warm and dry. Increased material wealth would keep two, three or even entire populations warm and dry on cold, rainy days and nights.

In the preface to the first edition of *Capital Vol. 1*, Marx writes that “[w]hat I have to examine in this work is the capitalist mode of production, and the relations of production and forms of intercourse [*Verkehrsverhältnisse*] that correspond to it” (Marx 1976:90). *Verkehrsverhältnisse* is a compound noun of *Verkehr* and *Verhältnisse*. *Verkehr* means traffic that, like its English counterpart, has connotations of movement and trade; *Verhältnisse* means conditions or relations. An economic form is, in other words, a theoretical abstraction of the relations of production (Marx 2008:119).³⁶ What is interesting for theorizing how things and people move is that Marx specifically refers to economic forms as forms of intercourse, which connotes communication, contact, and relations. In the German concept for economic form, the connection to movement is more explicit. The theoretical expressions of the relations of production are thus bound up with movement and the mobility of the things communicated. Economic forms must, therefore, be understood to be inherently concerned with the movement of trade and of establishing connections between individuals or groups.

As Heinrich explains, in generalized commodity societies “people do not relate to each other in a direct social way; they first enter into a relationship with one another during the act of exchange—through the products of their labour” (2012:73). Things thus have the social function of connecting people, and from this vantage point, the thing is an intermediary and consequently a bearer of the productive relation (Rubin 1973:31, 35). These social relations are naturalized with the effect that “it appears as if things have the properties and autonomy of subjects” (Heinrich 2012:73). In other words, we delegate agency to things. This delegation refers to, of course, Marx’s theory of the fetish; people act, move and come into contact with one another under a “material shell” (1976:185).

³⁶ For example, on the one hand, the commodity we encounter in the first part of the good book expresses the productive relation of private individuals that produce for one another in reciprocal independence; their labour is validated as social labour indirectly through the confrontation of their commodities at the market. On the other hand, the commodity we encounter as the result of capitalist production and as an objectification of surplus-value expresses the complex relation of capital and labour. In other words, the commodity expresses that a class of people in society has been divorced from the means of production and has no choice but to sell their labour-power for a wage in order to buy the commodities needed for survival.

Marx speaks of the distinction between natural and social form as *ökonomische Formbestimmung*, which translates as “economic form-determination” (Heinrich 2012:40). Form-determination is how Marx employs determinism in *Capital Vol. I*; as *Neue Marx-Lektüre* suggest, without it, the book would in effect be useless.

Understanding why this is the case requires a breakdown of what Marx means by the concept, which in turn necessitates a brief examination of the linguistic complexities of “determination.” As Raymond Williams explains, the root sense of the word is “setting bounds” or “setting limits”; in relation to economic behaviour, this should be understood as setting a limit or putting end to a given action (1977:84). To determine or be determined additionally means “an act of will and purpose” (Williams 1977:87). Thus, a human agent could determine to do something, and be determined in a given course of action. This determination, however, could just as well be external and therefore, determination is an “exertion of pressure” by something on an agent (Williams 1977:87). The German word *Bestimmen* has an additional meaning connoting “decision”, the implication being that a given course of action has always already been decided for the subject who carries it out (see Kjøsén 2013).

Naturally, this “determination” reeks a bit of that much-loathed (but misunderstood, I might add) determinism in which “some power (God or Nature or History) controls or decides the outcome of an action or process, beyond or irrespective of the will or desires of its agents” (Williams 1977:84). Although form-determination reveals that the power of value decides the outcome of processes irrespective of the will of its agents, this determinism has nothing to do with any preordained communist future as Marx’s detractors and people faithful to the Second International may believe. Form-determination is rather more mundane; it relates to everyday activities such as buying and selling (exchange/circulation) or making something (production/valorization).

Social forms determine how things (sensuous-concrete use-values) are treated by members of society. Consequently, if use-values are the material bearers of exchange-value they must be treated as such. For its owner, the commodity has no direct use-value,

but only use-value for others.³⁷ Because it is a bearer of exchange-value, the use-value in the hands of its producer and owner is first and foremost a means of exchange and something destined to become money rather than something to be immediately used and consumed (Marx 1976:179). The decision to sell the use-value has always already been made for the owner. Although he could give it away, that (almost) all objects of social need in capitalist society are commodities means that he has to sell it for money in order to buy other necessities of life. Commodity-owners *must* relate their commodities to money; society has already decided that the only rational course of action is to sell, sell, and sell! And although you can sit in the natural form of a chair, as a commodity it is not possible to enjoy this useful effect until it has been bought, which is an economic behaviour that executes money's social function.³⁸

With form-analysis, Marx is trying to do something that no political economist had done before him, namely to critique the forms that bourgeois political economy took for granted. Marx charges political economy with only considering the content of social forms and for confusing appearance for essence. Marx's intent with such a critique was to demonstrate that what political economy treats as the natural properties of things are in reality social properties that are derived from the aggregate behaviour of individual human beings as it is determined by capitalist social relations of production (Heinrich 2012:76-7).³⁹ Although capital appears as a collection of things that moves independently of individual human beings, this movement is actually a product of human behaviour and

³⁷ "All commodities are non-use-values for their owners, and use-values for their non-owners" (Marx 1976:179).

³⁸ Production is similarly determined. Although the labour process is always a process between humans and nature, it does not exist in a "pure form" but always in a socially determined form such as slave labour or feudalism. In the capitalist mode of production, the labour process is determined by the valorization process (Marx 1976:290-92; Rubin 1973: 31; Gray 2010; Heinrich 2012:99).

³⁹ In other words, the "behaviour of society" can be understood as how complex emergent behaviour arises from the behaviour of atomized individuals. Political economists, including Smith and Marx, were all interested in how the behaviour of economic agents was objectively mediated. For example, Smith (1986) used the metaphor of the "invisible hand" to explain how individuals through the division of labour serve each other's needs even though they are pursuing their own interest.

humanity's collective and generic, yet alienated capacity to create; because this behaviour is social rather than natural, Marx argues it can be changed and therefore that a society without commodities and money is possible. Arguably, the movement of things and people to the market is a characteristic that pertains to capitalist society and not to the thing itself. It is not given that things must "go to market"; in a mode in which production has been communized, they could go directly to where they are needed without the market as a detour. Importantly, for the purposes of this dissertation, understanding why the commodity must move to the market provides the first theoretical clue to the puzzle of what capital's media are.

1.3 "Personifications of economic categories"

In Marx's political economy individuals are personifications of the same economic forms that give things their social functions. In the opening to Chapter Two, Marx argues that as commodity-owners, individuals are the representatives of commodities, and as such merely personify the productive relation the commodity theoretically expresses. That is, by being the owner of a thing with a determined social function, they are reduced to executors of said function. To gain a better appreciation of this relationship between economic abstractions and individuals, it is necessary to consider in more depth how Marx treats individuals in his political economy. This treatment is such an important aspect of his value theory that he stressed it in the first preface to *Capital Vol. 1*:

To prevent possible misunderstandings, let me say this, I do not by any means depict the capitalist and the landowner in rosy colours. But *individuals are dealt with here only in so far as they are the personifications of economic categories, the bearers of particular class-relations and interests*. My standpoint from which the development of the economic formation of society is viewed as a process of natural history, can less than any other make the individual responsible for relations whose creature he remains, socially speaking, however much he may subjectively raise himself above them (Marx 1976:92, emphasis added).

In *Capital Vol. 1* we encounter only "humans without any individuality" and the portrait of society painted is one of an "abstract negation of individuals" in the inverted world of

capital; inverted because it is a world that is a product of alienated human activity (Reichelt 1982:168).⁴⁰ In his narrative, Marx presents people “only insofar as they have intercourse with one another as character-masks” (Reichelt 1982:168). As such, human individuals are nothing but the *dramatis personae* (“persons of the drama”) of the economic drama that is capital/*Capital* (Marx 1976:206).

Metaphorically, individuals are assigned roles to play by society, i.e. they are interpellated as subjects by capital’s economic forms (Kjøsen 2013). When Marx introduces the intercourse between human individuals in Chapter Two, they are wearing the commodity as a character mask and have been assigned the roles of sellers and buyers. It is important to note, however, that these roles are temporary; at a different time and place, the one and same individual may, depending on the structural necessity of capital, play a different role with the consequence that their “physiognomy changes.” If the individual playing the role of seller is wearing the particular character mask of the labour-power commodity and the buyer is wearing that of capital, “a certain change takes place, or so it appears, in the physiognomy of our *dramatis personae*. He who was previously the money-owner now strides out in front as a capitalist; the possessor of labour-power follows as his worker” (Marx 1976:280).⁴¹

Hence, the role or subject position—what *Wertkritik* calls “subject form” (Jappe 2013) — of any individual is determined by the economic category they personify, which is to say that the individual becomes a bearer of the associated relation of production. The capitalist’s status is determined by ownership or control over capital, the means of

⁴⁰ The capitalist is thus a personification or representative of capital (Marx 1976:342, 424, 739) and the worker is “nothing more than personified labour time,” (Marx 1976:352-3), while at the market we all represent commodities and money irrespective of our relationship to the means of production; we are therefore commodity and money-owners who become sellers and buyers when we respectively sell and buy (Marx 1976:206).

⁴¹ In the third part of *Capital Vol. 2*, Marx (1978:245) demonstrates how the economic roles of worker and capitalist come to over-determine that of buyer and seller; the individuals who repeatedly appear on the market as sellers are capitalists, while workers appear as buyers, although this relationship has its basis in the purchase and sale of labour-power.

production, and products of wage-labour; the status of the worker is determined by ownership of labour-power; and the landlord is determined by ownership of land (Rubin 1973:19). Moreover, it is through these various productive relations that these subjects come into contact with one another. Thus, the landowner may come in contact with the industrial capitalist because the latter needs to rent the former's land; the worker comes into contact with the capitalist by selling her labour-power to him. Given this dissertation's circulationist approach, we are, however, not concerned with these productive relations, but rather with the ones that make individuals into buyers and sellers on the market. The status of the commodity's guardian—who is also a seller—is determined by his ownership of a commodity.⁴²

We can now better appreciate the peculiar opening of Chapter Two, considering it is the first time he introduces people and their behaviour on the market. Marx's presentation in Chapter One appears to be deliberately fetishistic, with commodities appearing out of nothing and confronting or having intercourse with one another. There is never recourse to a human agent, yet by examining the form of the commodity and observing their exchange formally in Chapter One, Marx can reveal how the activity of individuals at the market is determined, i.e. decided or limited by the economic abstraction "commodity." As Marx argues:

In their difficulties our commodity-owners think like Faust: 'In the beginning was the deed.' They have therefore already acted before thinking. The natural laws of the commodity have manifested themselves in the natural instinct of the owners of commodities (Marx 1976:180).

Although people engaged in economic activity, such as the exchange of commodities, are formally free in their behaviour, "as commodity-owners they must follow the laws imposed on them by the nature of commodities." (Heinrich 2012:63). In the opening of Chapter Two, these laws can be summarized as: 'go to market and perform exchanges'—a social command given by value and relayed by the commodity to its guardian.

⁴² In the capitalist mode of production we all relate to each other as owners of commodities. Commodity-owner is the default subject form from which all other subject forms are developed, such as capitalist and worker. All subject forms are therefore developed from the commodity as the elementary form of capital.

1.4 Determined movements

What, however, has form-determination and personification got to do with movement? Marx does not speak of the commodity's movement and trajectory to the market as a determination of that particular social form. In Chapter One, he does not mention the market or the movement of any things or people.⁴³ The entire analysis of that chapter is devoted to the commodity form and developing the form of value. But why did Marx include the language of “go[ing] to market” in the opening to Chapter Two? After all, he could have just written: “commodities cannot perform exchanges in their own right.” Indeed, limiting the opening statement to performing exchanges would make sense both in relation to the object Marx discusses in Chapter One, but also to what he discusses in Chapter Two, namely the exchange acts of commodity owners. The only real movement Marx discusses in that chapter is the spatial movement whereby commodities “change hands” as a necessity for a transfer of property (1976:178-9).

In *Capital Vol. 2*, Marx specifies that not all commodities have to go to market. Some commodities, like a house, are incapable of moving. In the conclusion to this chapter, I argue that the phrase “go to market” can be understood as identifying a necessary *mediating* function that also consists of the functions of storage and processing. For the sake of argument and to establish the logical necessity of this mediation, I assume that all commodities have to go to market.

I argue that movement to the market should be understood as belonging to the form-determinants of the commodity form because this spatial movement is specific to capitalist societies. The market as a specific location in space—with a temporal permanence beyond specific market days or festivals and where everything needed for survival is bought and sold—is particular to capital and emerged as a result of the

⁴³ While Marx does not mention any movement of things or people (or the market for that matter) in Chapter One, phrases like “enter into association” or the passive “brought into relation” stand in for movement.

commodity's generalization (see Braudel 1979:29-33).⁴⁴ Although the traffic of things and people to the market may appear as natural and the rationality behind that traffic is nothing but common sense to members of capitalist societies, it is far from natural why this movement occurs and why it is that *all* things of social need must move via the market before they can be used. This movement is a characteristic of capitalist societies and not of the things themselves. Use-values need not be bearers of exchange-value; in another mode of production and arrangement of social and political life, it would have a different social form.

In a society in which production is communized, things could go directly to where it was needed, their movements being predicated on the ethics of “from each according to ability, to each according to need” which renders both the market and exchange of products of labour superfluous. While every dad, and quite a few mothers, has gotten a drill for Christmas, is the social need for drills so large that every father and every other mother need to own one? If things are not commodities, but appear in the social form of the common, they would move within a delineated community according to where they would be needed or used next. Equipped with radio frequency identification chips (RFID) and assigned an IPv6 address, they would be searchable on the communist Internet of Things, and could therefore be stored where they were last used and ready to be retrieved by the next user; alternatively it could be directly delivered to where it is scheduled to be used next or simply returned to the communal stores.⁴⁵

⁴⁴ Markets and the movement of things and people are not exclusive to the capitalist mode of production. Markets, commodities and the latter's movement towards the former are all both logical and historical presuppositions of capital; they did not appear *ex nihilo* at the advent of capitalism. However: “Sales were for a long time confined to certain days of the week, but became daily in the eighteenth century” (Braudel 1979:33). Of course, it is only when things are produced as commodities that all of them have to be exchanged at the market. Prior to generalized commodity exchange, given that production was for subsistence there was no need to bring anything but a surplus of subsistence production to the market.

⁴⁵ The so-called “sharing economy” represented in apps like *Airbnb* and *Uber* indicate the potential for more efficient use and movement of social use-values, albeit still encased in the commodity form.

Marx's argument that the social form of the commodity determines the activity of the commodity-owners can be used to interpret the statement "go to market" as the commodity-owner being either pushed, pulled or dragged by the commodity. When use-value is a bearer of exchange-value, the thing in my hands is not of direct use; it is a medium of exchange that I, therefore, take it to the market so that it can be sold and transformed into money. We also "follow the money" in a similar fashion, albeit to buy.

A striking example of how individuals' movements are determined by the economic abstractions of commodity and money can be found in the efforts to fight the 2014 Ebola outbreak in Western Africa. Infectious diseases like Ebola rely on people as epidemiological vectors, i.e. as the agents that carry and transmit infectious pathogens into other living organisms. The efficiency of our transportation network means that Ebola can spread worldwide if the outbreak is not contained and human vectors enter the international aviation network. Where the disease spreads is dependent on where people go and come into contact with one another. Limiting the spread of Ebola, therefore, requires that people's movements be restricted, which is precisely what the United Nation's World Food Program (WFP) did in northern Liberia by intensifying food distribution (Reuters 2014). Food distribution accompanied the health response because it eliminated a chief reason for why people would leave their villages, thus containing the spread of Ebola. To make people stay as close as possible to home, regional director Denise Brown explains, the WFP's contribution in combatting Ebola is "to provide them food so people don't have to go to the market; they don't have to go to the shop; they don't have to go to the field; they can stay home where they have something to eat" (Reuters 2014). Commodities have the social function of connecting people; because they have to be sold and are sold in markets, private and isolated individuals are brought into contact when they take their commodities and money to the market. Normally, rural Liberians would have to travel to the market where they could use their money to buy food; they would have followed the money to where their needs could be met and consequently risked infection. By distributing food directly to where it is needed,

however, a reason for people's movements and coming into contact with one another is therefore eliminated; the commodity cannot function to connect people.⁴⁶

What this case study reveals—as did the introductory examples of food leaving famine-stricken areas and Amazon's anticipatory shipping—is that there is a given logic of movement that emanates from the form of the commodity that its personifications must follow. The commodity's social function of being sold and connecting people must often occur at particular locations in geographical space. The salient point is that the economic form determines the activity; thus, wherever the commodity can execute its function, its (human) personification must move.

The logic of movement is based on the immanent contradiction of the commodity, which Marx characterizes as a sensible-supersensible thing. The sensible, phenomenal aspect of the commodity refers to its natural form, while its supersensible, metaphysical quality emerges from the social form of the commodity itself, i.e. value. In the introduction, I referred to this division in terms of real and formal movements. As my analysis demonstrates, that the sensuous-concrete commodity must go to market is predicated on its supersensibility—the being of value. For exchange to occur, the market must be supplied with commodities, not just one, but all of them. Their spatial location belongs to commodities as a physical attribute (Harvey 2006:338, 375), but their reason for being at the market belongs to them as values. The supersensible therefore haunts the real movement of commodities; they are, as I argue below, driven forward in time and space by the immanent contradiction of the commodity.

Bringing form-analysis to bear on movement has some important implications. The chief implication is that the movement of things and people must be based on the social form of things rather than the thing itself. Hence, the point of departure cannot be the physical

⁴⁶ A question begs: would there be less movement of people in a communist society given that objects of social need would be distributed directly to where they are needed? I am not, however, arguing that there would no reason to move at all, but I question whether the day-to-day activity of people going to stores and malls would exist as it does today.

properties of things, i.e. their natural forms, as determining mobility or why any movement is required at all.

David Harvey argues that capital's mobility depends on the particular economic form it assumes at any given moment and that movement in a given form may be easier, more difficult or not possible at all (2006:373-87). In this otherwise interesting discussion, however, he refers almost exclusively to their physical qualities. For example, on the commodity's mobility Harvey lists attributes such as "weight, size, fragility, perishability", and with reference to money he refers to their "forms" as "gold bullion, coins, notes" and argues that credit money is the "most mobile of all" and can "move around the world as quickly as information" (2006:376, 385-6). In other words, he focuses on the natural rather than the social form of things. The physical properties of money, commodities and production processes do influence how capital moves in the sense of the ease of movement, the speed, and the care that must be taken when handling them—for example, it is much easier to move electronic money than a production process, which consists of buildings and machines fixed to a particular place—but Harvey does not consider how the economic forms may determine movement in the first place. It may be common sense to argue that commodities must move to the market and that depending on their weight, size, and fragility this movement may be easier or more difficult, but Harvey does not examine why this is the case or why any things appearing in economic forms must move in the way that they do. In other words, he fails to appreciate the difference between the formal determination of movement and the logistical problem of transporting capital from A to B. This logistical problem is, however, determined by the formal movement of capital through its circuit. Harvey forgets, to paraphrase McLuhan that the value-form is the message; he confuses things for the social form in which they appear.⁴⁷

⁴⁷ Indeed, as *Criticuff's* (n.d.) review *A Companion to Marx's Capital* observes, Harvey (2010) does not have an appreciation of why value must assume the value form or what abstract labour is, concluding that "those who read *A Companion* to guide them through *Capital* will be disappointed: it neither gives an adequate account of what Marx said nor of the capitalist mode of production" (*Criticuff's* n.d:n.p).

Omnes viae Romam ducunt, but in the Empire of Capital, all roads lead to the market. Why must commodities “go to market”? The simple answer to this question can be found in the opening to Chapter Two where Marx established a direct relationship between movement and exchange: the former supports the latter. The problem is that Marx does not discuss this material movement with the same nuance and detail as he does with exchange (formal movement), but rather leaves it for *Capital Vol. 2*. That there is a relationship between movement and exchange, however, means that analyzing why the commodity must go to market must be done based on why the commodity must be exchanged.

In order to continue with the analysis, it is necessary to turn to what Marx analyzes in Chapter One: the commodity, value, the value form, and the commodity’s internal contradiction. In other words, the chapter concerns one of Marx’s crucial critiques of political economy. While he recognized that bourgeois political economists had identified the connection between labour and value, Marx argued they had “never once asked the question why this content has assumed that particular form, that is to say, why labour is expressed in value, and why the measurement of labour by its duration is expressed in the magnitude of the value of the product” (1976:173-4). In the following discussion, I argue that the reason for why the commodity must move to the market is precisely because labour must take the form of value.

1.5 “The immanent contradiction”

Marx characterizes the commodity as a “sensuous-supersensible thing” and introduces it as an immediate but contradictory unity of use-value and value. Although commodities come into the world “in the form of use-values”, they are commodities only insofar as they possess a “double form, i.e. natural form and value form” (Marx 1976:138). The commodity is, therefore, a unity or contradiction of sensuous-concreteness and supersensible-abstractness: between use-value and value, and concrete and abstract labour (Reichelt 2005:39). This contradiction must be resolved, which occurs during

exchange. But to arrive at this resolution, I first deal with use-value and value analytically.⁴⁸

From the point of view of use-value, commodities “go to market” because of the social need that exists for their use-values. The heterogeneity of these use-values reflects a social division of labour (Marx 1976:132); use-values must move because they are needed where they are not produced. As already discussed, this movement need not travel via the market; its trajectory *could* take use-values directly to where they are actually needed. But as the famine example demonstrates, food in commodity form moves away from where there is desperate need for it. Although use-value alone cannot adequately explain why the commodity must move via the market, the existence of qualitatively different use-values is nevertheless vital for this movement. After all, it would be pointless to exchange a coat for another identical coat. When private producers produce for one another in reciprocal independence, they are no longer engaged in subsistence production, but the production of commodities for other people. They, therefore, do not treat their commodities as use-values, but as something to be exchanged for other things they need.

In Marx’s theoretical framework form determines content. What turns a use-value into a commodity is exchange. It, therefore, appears as if the commodity has an exchange-value. Marx argues that exchange-value appears initially as “the proportion, in which use-values of one kind exchange for use-values of another kind” (1976:126). A given use-value will exchange for other use-values “in the most diverse proportions”, meaning that any individual commodity has many exchange-values instead of just one (a quarter of wheat can have the exchange-value of x coats, y linen and z Bibles) (Marx 1976:127). What makes use-values commensurable, however, is neither use-value nor exchange-value. The diversity of valid exchange-values means that they “express something equal” and that exchange-value is the “form of appearance” of “a common element of identical

⁴⁸ While Marx’s method of presentation in *Capital Vol. 1* is dialectical, in the first chapter he presents the commodity in an analytic manner, alternating between the points of view of use-value and exchange value rather than positing their relation to other commodities as a totality (Reichelt 2005:43).

magnitude” in two different commodities (Marx 1976:127). In other words, what makes commodities exchangeable is this common element, which is an abstraction from the use-value of commodities (Marx 1976:127).

Abstracting from the use-values or natural forms of commodities means that all their “sensuous characteristics are extinguished” with the only property remaining that they are products of labour (Marx 1976:128). They are not products of this or that particular concrete labour, however, because disregarding the use-value of the commodities means that the useful labour embodied in them also disappears, so they “are all together reduced to the same kind of labour, human labour in the abstract” (Marx 1976:128). Marx refers to abstract labour as a “social” and “value-forming” substance and argues that commodities are values as “crystals of this social substance” (1976:128).⁴⁹ This abstraction exists in the commodity, as the “objectivity” of value and the “coagulate” or “crystallization” of abstract human labour (Marx 1976:141; Reichelt 2005:39). The objective properties of things are typically considered to be inherent irrespective of their relationship to other things (Heinrich 2012:53-4). For example, a banana and the Pokémon Pikachu have the colour yellow in common irrespective of their relationship to one another. If the colour yellow were like value, however, the banana and Pikachu would be yellow if and only if they were next to one another (see also Heinrich 2012:53). The objectivity of value must thus be understood as something materially different from any given commodity, yet common to it and all other commodities (Marx 1976:142).

The abstraction that occurs during exchange also establishes a quantitative equivalence between the two commodities: they contain an equal quantity of value, i.e. the same expenditure of identical human labour-power (Marx 1976:129). The measure of value is, therefore, labour-time. It is not the case, however, that a use-value would be more

⁴⁹ The commodity’s two factors are reflected in the dual character of labour with concrete labour mapping onto the category of use-value, while abstract labour maps onto value. Although any act of labour producing commodities is simultaneously concrete and abstract, “in so far as it finds its expression in value, it no longer possesses the same characteristics as when it is the creator of use-values” (Marx 1976:132). The labour contained in the commodity counts qualitatively with reference to use-value, and quantitatively in reference to value (Marx 1976:136).

valuable if someone spent more time to make it than someone else. The value of a commodity is rather *socially necessary labour-time*, which is the labour-time “required to produce any use-value under the conditions of production normal for a given society and with the average degree of skill and intensity of labour prevalent in that society” (Marx 1976:129). The quantitative abstraction that occurs during exchange is therefore that individually spent labour-time is reduced to socially necessary labour-time so that the two use-values are quantitatively as well as qualitatively equal as values (Marx 1976:129-30).

That value is an abstraction means that it cannot be expressed as value *per se*, but can only appear in an “inverted form” as a relation of two use-values (Backhaus 1980:101). It is in this relation that use-values are revealed to be the bearers of exchange-value. It is also in the relationship between two commodities that a commodity acquires a value form distinct from its natural form (Marx 1976:143). As Marx argues:

By means of the value-relation... the natural form of commodity B becomes the value-form of commodity A, in other words the physical body of commodity B becomes a mirror for the value of commodity A. Commodity A... in entering into a relation with commodity B as an object of value, as a materialization of human labour, makes the use-value B into the material through which its own value is expressed (Marx 1976:144).

In other words, the use-value in the equivalent form is exchange-value, meaning that the use-value (natural form) of commodity B is the exchange-value of commodity A; for example one coat is the exchange-value of 20 yards of linen.

The commodity form is based on an “immanent contradiction” between use value and value; this contradiction is “represented on the surface by an external opposition” where the commodity “*whose own* value is supposed to be expressed, counts directly only as a use-value, whereas the other commodity, *in which* that value is to be expressed, counts directly only as exchange-value” (Marx 1976:153). Although value is a social property that only exists within a relationship, the peculiarity of the equivalent form means that

value “*appears* to be an objective property that is also inherent outside of this relationship” (Heinrich 2012:54).⁵⁰

Based on Marx’s analysis, I argue that the imperative to move the commodity to the market is not merely to sell an individual commodity that “has” value, rather the quality of having value only appears in the relation between two concrete use-values. As proponents of *Neue Marx-Lektüre* stress, prior to exchange the commodity, strictly speaking, does not have value (Bidet 2008; Ramsay 2009:nd; Heinrich 2012:54-5). Value arises neither in production nor in exchange; instead, the one presupposes the other, meaning that value is constituted in the shuttle between production and exchange. The reason the commodity must “go to market” is because of its immanent contradiction; the peculiar ontology of value requires it to appear in its form. The logic or determination behind the movement of things and people is, therefore, exchange-value. That is, because the individual commodity does not have value; value is only the movement whereby it changes form into money; hence, on its own and standing still, the commodity is devalued as value.

The analysis of the relationship between value and movement could end here, but the problem with the direct exchange of products (barter) is that value’s movement ends as soon as the individual acts of exchange are done. That is to say, although the appearance of value in its form of exchange-value seems to have resolved the commodity’s immanent contradiction, it is only a temporary one. Barter exchange is a slow process because commodity-owners can exchange with one another only if they are in possession of the use-value the other one needs. Barter is, therefore, an impossible basis for generalized exchange, which requires that the values of all commodities are mirrored in a “higher form” (Day 2005:xxx).

⁵⁰ The commodity thus “reflects the social characteristics of men’s own labour as objective characteristics of the products of labour themselves, as the socio-natural properties of these things” (Marx 1976:164-5). The result is that we have delegated agency to things through inverting our human social relations into “material relations between persons and social relations between things” (Marx 1976:166). That is to say, nothing gets done and nothing moves unless it is for the purpose of commodities changing hands for money.

1.6 “Room to move”

This higher form comes into existence by the commodity going through a process of cell-division—what Hegel refers to as a “doubling” whereby it “contrasts itself with itself” (Backhaus 1980:109). Marx considers the commodity to be the cell-form or “germ” from which capital can be developed (1976:90, 125, 163). Due to his admiration of Charles Darwin, Marx was fond of using biological metaphors to explain his political economy. In biology, a germ is something that can serve as the basis for further growth and development: its specific biological connotation is the earliest form of an organism from which a new organism or one of its parts may develop, while the cell is the basic structural and functional unit of living organisms and a building block of life. As a “germ form”, the commodity is the basis, the earliest form of and presupposition of the organism known as capital.

For this germ form to “double” and expand, however, one commodity must be singled out to count directly and exclusively as the independent form of value, i.e. to be the material that is a quantitative and qualitative “equivalent” for all other commodities. Through “an act of society”—in essence, multiple repeated exchanges at the market—a particular commodity that is suited to mirror the value of the world of commodities, is turned into what Marx calls the universal (or general) equivalent (1976:180-1).⁵¹ The universal equivalent is directly exchangeable with all other commodities and is thus the thing against which the value of “every emergent commodity” must be compared (Marx 1976:159). The universal equivalent is money. The internal contradiction of the commodity is thus “doubled” by giving value an independent form in money. This doubling externalizes the immanent contradiction between use value and exchange-value:

⁵¹ Heinrich (2004), argues that the necessity of money being a commodity is no longer valid in terms of belonging to Marx’s presentation of the ideal average of capitalism, but was rather part of a special period of capitalist development. Heinrich writes: “The money commodity however doesn’t belong to this ‘ideal average’. In this case Marx confounded a transitional attribute of the capitalist money system with its ‘ideal average’” (2004:n.p.).

The need to give an external expression to this opposition for the purposes of commercial intercourse produces the drive towards an independent form of value, which finds neither rest nor peace until an independent form has been achieved by the differentiation of commodities into commodities and money (Marx 1976:181).

One of the few methodological comments Marx makes on dialectics in *Capital Vol. I* is on “the way in which real contradictions are resolved” (1976:198). Noting that the exchange of commodities “implies contradictory and mutually exclusive conditions,” he argues that the further development of the internal contradiction into an external expression “does not abolish these contradictions, *but rather provides the form within which they have room to move*” (1976:180, emphasis added). In relation to the commodity, this room-giving form is money.

But why does the money form give the internal contradiction of the commodity “room to move”, and how does it help explain why the movement of “going to market” as necessary? The process of exchange transfers commodities from hands in which they are non-use-values into those in which they are use-values. What occurs during exchange is not that a product of useful labour replaces that of another, but that the commodity changes form into money. Indeed, value is nothing but the “movement” whereby value changes form from the commodity into money. By gaining an independent form in money, value can be formally defined as the metamorphosis of the commodity into money or C—M. Marx refers to this metamorphosis as a “formal movement.” Moreover, this formal movement must be materially mediated by the commodity’s guardian bringing it to the market to perform exchanges.

Marx argues that the “antithetical phases of the metamorphoses of the commodity are the developed forms of motion of [the] immanent contradiction” (1976:209). The antithetical phases Marx refers to are the respective functions of the commodity and money, namely sale and purchase. The room in which the immanent contradiction has room to move is the circulation of commodities (C—M—C), with the individual movements C—M and M—C respectively representing sale and purchase (Marx 1976:200). The movement C—M—C does not only represent the abstract room in which the internal contradiction moves, but also—because value only appears in unity with use-value—value’s being.

The circulation of commodities differs both in form and essence from the direct exchange of products. While it is impossible to sell unless someone buys, there is no need to buy something immediately and go through the inverted phases of the commodity's circuit at the same time and place. Money can be hoarded for later use someplace else (Marx 1976:161).

Circulation bursts through all the temporal, spatial and personal barriers imposed by the direct exchange of products, and it does so by splitting up the direct identity present in this case between the exchange of one's own product and the acquisition of someone else's into the antithetical segments of sale and purchase. *To say that these mutually independent and antithetical processes form an internal unity is to also say that their internal unity moves forward through external antitheses* (1976:209, emphasis added).

Money gives the internal contradiction room to move because it splits up the direct identity of exchanges by inserting intervals of time and space into the process of exchange. Money provides capital a *Lebensraum* in which the immanent contradiction can expand on a global—or, hypothetically, even interplanetary basis (Stross 2006).⁵²

When Marx introduces the circulation of commodities, he argues, yet again, that “in and for themselves” commodities “lack the power of movement” (1976:211). What is the difference between the statements ‘commodities cannot themselves go to market’ and ‘commodities lack the power of movement’? Why does Marx make what appears to be two almost identical statements? When value assumes an independent form in money, it becomes the means of circulation because it is the only commodity that is directly exchangeable with all other commodities, which is to say that it is the only material to which commodities can compare their values. Money is the social motor of commodities because they would not go to the market in the first place if not for money's promise to take their place and divest them of their shape, thus removing the use-value from the

⁵² This splitting up of the unity of sale and purchase makes it possible for a crisis to develop (Marx 1976:209). Arguably, Harvey's (1990:182-4; 2005:109-16) notion of capital's “spatio-temporal fix” during times of crisis has its foundation in the division between sale and purchase. During times of crisis, overaccumulated capital can be advanced or utilized through “temporal deferral and geographical expansion” (Harvey 2005:115).

sphere of circulation into that of consumption or production. *Money* becomes the social reason for why the commodity must “go to market”;

Exchange... produces a differentiation of the commodity into two elements, commodity and money, an external opposition which expresses the opposition between use-value and value which is inherent in it. In this opposition, commodities as use-values confront money as exchange-value... *These antagonistic forms of the commodities are the real forms of motion of the process of exchange* (1976:199, emphasis added).

To conclude this chapter, I turn to the implication of my analysis of value’s movement for a theory of capital’s media.

1.7 Conclusion: the commodity’s prosthesis⁵³

The opening to Chapter Two can be interpreted as Marx describing a logistical support system for the commodity and its social function, i.e. a logistical support for the exchange of commodities. This system consists of two guardians who use their respective feet and backs to bear the bearers of exchange-value to the market.⁵⁴ Such logistical support is necessary because the commodities as things are inert and have no means of auto-locomotion. They require someone or something to set them off on their journey to the market.⁵⁵ In other words, the commodity must be made capable of movement—it must be mobilized so it can “go to market.” This phrase describes a function of capital’s media because it is a material mediation of the formal movement of value, or, what I say

⁵³ The discussion of the guardian as a vehicle for the commodity and the logistical support it provides value is inspired by Paul Virilio’s kitsch anthropology and dromological history of transportation vehicles and military acceleration from *Negative Horizon* (2005).

⁵⁴ At the market, the guardian serves in yet another logistical capacity as the communicator of commodities’ prices. The value of a commodity is invisible and its relationship with money exists only ideally until it is exchanged. Therefore, Marx argues, the “guardian of the commodities must therefore lend them his tongue, or hang a ticket on them, in order to communicate their prices to the outside world” (1976:189). The commodity thus also mobilizes its owner’s tongue by commanding it to communicate its price in order to facilitate its exchange.

⁵⁵ Presumably the commodity’s point of departure is where it was produced. Marx, however, never mentions fields, factories, and workshops in either the first or second chapters of *Capital Vol 1*.

is the same, the circulation of commodities. “Go to market” thus refers specifically to the function media theory refers to as transfer (see e.g. Kittler 1996; Innis 2007; 2008). Without this spatial transfer the commodity’s exchange would not be possible and, as I explain in chapter six, this function is expressed in the category of capital’s media.

Although it is the guardian that makes the commodity physically mobile, that the guardian is determined to do this means that in relation to the function “go to market,” the guardian should be treated as a vehicle: a metabolic means of transportation. To take somewhat of a long logical leap we should, therefore, as Friedrich Kittler (2010:29) suggests, not privilege the guardians as subjects because they are human, but rather think of their bodies in terms of technologies. Not only is the guardian determined to carry out exchange, but also specifically to function as the commodity’s—and therefore by extension value’s—vehicle and logistical support. The guardian is therefore logically the first example of what I term capital’s media and (if he had thought of bodies as technologies) what Marx refers to as the ‘means of communication and transport’ we encounter in *Capital*. Formally, the guardian is the content of the category “capital’s media of transfer.” Specifically, the guardian functions as a medium of transfer by bearing the bearer of exchange-value to the market. The importance of the guardian as the first means of transport is that it provides the commodity with means of locomotion and a good payload capacity, thereby giving the commodity its “freedom” of movement to the market. But in this way, Man is no different from a horse, container ship or any other things that give the commodity logistical support by extending it in space. The difference between these different functional media is merely one of speed, payload capacity, and intelligence.

In addition to transfer, media theory refers to the functions of storage and processing (Kittler 1996). As I discussed above, the commodity is the elementary form of capital from which Marx develops more complex forms, such as money and capital. Although I take an analytical rather than a dialectical approach to developing the functions that are expressed in capital’s media category, “go to market” is the elementary media function—

the logical point of departure—from which I develop the other functions of capital’s media.⁵⁶ It is, therefore, necessary to critique my one-sided focus on transfer and the determination of movement in this chapter because, as I noted earlier, it is actually not the case that any and all commodities have to go to the market before they can be exchanged. In *Capital Vol. 2*, Marx writes that the exchange of commodities

may require a motion of the products in space, their real movement from one location to another. But circulation of commodities *can also take place without their physical movement*.... A house that is sold by A to B circulates as a commodity, but does not get up and walk. Moveable commodity values, such as cotton or pig-iron, can remain in the same warehouse while they undergo dozens of circulation processes, and are bought and resold by speculators. What actually moves here is the property title to the thing and not the thing itself (Marx 1978:226, emphasis added).⁵⁷

Commodities need not *physically* go to a spatially removed market—think of digital commodities that you download from a server farm after you have bought them; the market can thus be where the commodity is produced, and/or stored, and commodities can complete multiple formal movements before they actually move to the buyer that ends up consuming them (Kjøsen 2010). That Marx writes “may require a motion” and that exchange can occur “without their physical movement” means that the statement “go to market” from the logistical opening of *Capital Vol. 1*’s second chapter, can be interpreted as a logical determination or necessity that can more broadly be understood as preparing the commodity for exchange.

“Go to market” as a logical determination for the sale should, therefore, be understood in the sense that the commodity must be prepared for sale and readied for circulation. “Go to market” thus refers specifically to media theory’s function of transfer, while preparing

⁵⁶ In *Grundrisse*, Marx’s references to the “spatial condition” and the “necessary condition for circulation” of the “locational moment” can be treated as equivalent to the statement “go to market” from the opening to *Capital Vol. 1*’s Chapter Two (Marx 1973:533-4; 1976:188).

⁵⁷ That Marx introduces physical movement in *Capital Vol. 2* indicates that movement may actually belong to the social form of capital rather than to the commodity.

the commodity for exchange refers to media theory's trifecta of transfer, storage, and processing.⁵⁸ For example, in *Capital Vol. 2*, Marx argues that "without the commodity stock, no commodity circulation" (1978:223). While Marx is making an argument about the formal movement of value, it is also the case that the commodity's actual movement is conditioned by the existence of inventory in the sense that prior to or after the commodity has "performed" its exchange, it is retrieved from inventory that is stored in a warehouse. The preparation of the commodity for sale, in the case of the pig iron, is as simple as storing it in a warehouse, but most commodities are usually first placed in some type of packaging for protection and/or preservation, but also to make it portable and sellable. Indeed, many commodities "literally did not exist until they were packaged" (Hine 1995:16). In the case of a Mp3, preparation includes uploading it to a server-farm, entering it into a database to which a website (e.g. Amazon.com) or app (iTunes Store or Google Play) points to and which also describes to the buyer what the commodity is.⁵⁹ Of course, there are cases where the commodity is exchanged even before it has been produced, with car manufacturing being perhaps the most salient example. In these cases, the commodity that is exchanged must nevertheless move, i.e. be transported or transmitted after its exchange to whoever has bought it. And in the case of the immobile house, documents move in its place.

I should emphasize that the argument I am making is a logical one, couched in form-analysis. That the commodity's guardian is value's first logistical support and the commodity's vehicle is observed from the vantage point of Marx's dialectical presentation and not that of capitalism's actual historical unfolding; while human beings were historically among the first of capital's vehicles by using their backs and feet or

⁵⁸ I take the notion of preparing the commodity for sale from Gerald Sussman's (2012) interpretation of Kjosen's (2010) analysis of digital piracy and how selling digital commodities can be profitable. With reference to the latter, Sussman writes: "Capital in fact must withhold the release of digital commodities *in order to prepare for its circulation* (advertising, marketing, etc.)" (2012:484, emphasis added).

⁵⁹ In the case of digital commodities, the preparation of the commodity for sale may include locking its use with digital rights management (DRM), which preserves the value of the commodity by protecting it from theft. As such, DRM is an example of capital's storage media. I discuss why this is the case in chapter six.

pulling carts to move their products of labour to market, they were used alongside horses and carts, and sailing ships and barges (Braudel 1979).⁶⁰ In any case, human feet cannot walk very far or fast before they get tired, and backs give out after carrying heavy loads. Human vehicles give way to beasts of burden that are stronger, faster and have more endurance, but these, in turn, give way to technological vehicles and logistical support systems represented in the infrastructure of supply chains capable of mobilizing and moving immense collections of commodities that are produced at “feverish velocity” (Marx 1976:506).

It is not only human material that is mobilized for the production and subsequent movement of value but rather necessary and sufficient logistical networks that comprise human and non-human agents, energy, information and infrastructure, i.e. combinations of organic and technological media with respective metabolic and technological motors. In the chapter on 'Machinery and Large-scale Industry', Marx (1976:505-6) argues that industrial production of commodities necessitate the mobilization of an appropriate logistical infrastructure capable of absorbing and moving commodities in the quantity and speed that large-scale production requires. What starts out as a logistical network comprised of two commodities-owners using their feet and backs to move commodities (Marx 1976:178), turns or is remediated into a network consisting of river steamers, railways, ocean steamers and telegraphs and a world market (Marx 1976:506). The apotheosis of the commodity's logistical support today is best represented in intermodal transportation, distribution centers, and payment systems, all of which I discuss in part two of this dissertation. The 21st-century logistical supports of commodities extend the potential reach of exchange and trade at ever greater distances from points of production, its telos being the world market and the planetary infrastructure that supports it.⁶¹

⁶⁰ Of course, the one commodity that comes with its own means of locomotion is labour-power. This commodity, while determining its owner just like any other, really can “go to market and perform exchanges” in its own right.

⁶¹ With the construction of space elevators and colonization of the solar system, capital's logistical support would have to be capable of serving an interplanetary market.

2 The General Conditions of Logistical Capitalism

With the rise of global supply chains, even the simplest purchase relies on the calibration of an astonishing cast of characters, multiple circulations of capital, and complex movements across great distances.

—Deborah Cowen, *The Deadly Life of Logistics*, 1.

Capital Vol. 1 starts with the phenomenological argument that in societies in which the capitalist mode of production predominates, wealth “appears as an ‘immense collection of commodities’” (Marx 1976:125). But how would capital appear to a transhuman being with more than five senses, a capacity for dividing its attention without limitation and an omniscopic view of the earth? What it would see would not be immense collections of commodities as they appear to human individuals in retail stores and warehouses, but the material movement of capital in its totality. To this transhuman entity, capital would appear as an immense collection of ships, trains, trucks and planes that move according to a network constituted by the infrastructure of highways, railways, and different ports, linking various facilities for producing, storing and distributing commodities. Capital would, in other words, appear as a planetary supply chain.

We have examined *why* value must move, and also demonstrated that it must be mobilized by someone or something else—the commodity’s guardian—to serve as the “means of communication and transport.” This chapter picks up on and continues these two lines of analysis. That the guardian is the first example of the means of communication and transportation (or what I term capital’s media) that appears in *Capital* requires that I examine what Marx wrote about these means. This examination is important because it concerns the position of these means as a category in Marx’s total system of categories and, materially, in the social process of production. This chapter begins with considering how the means of communication relate to what Marx’s terms “the general conditions of production.” The chapter then turns to *how* capital moves in the sense of what paths and routes it takes (i.e. where capital moves). Whereas the commodity merely goes to the market to perform exchanges, the movement of capital is more complex. Starting from the contemporary phenomenon of the supply chain, I show

how the circuit of capital represents an abstract grid according to which things appearing in economic forms and personified economic categories must move. Moreover, I argue that the circuit form-determines the supply chain to move matter in order to perpetuate the abstract being of capital. In terms of movement, this chapter thus focuses on the spatial arrangement of the various points capital moves between (production and exchange). The chapter argues that capital's media has increased in importance after production became organized into regional and global supply chains.

2.1 The means of communication and the general conditions of production

In order to delineate the category of capital's media and the functions it expresses, and to position this category within Marx's system of categories and the functioning of media within the social process of (re)production, it is helpful to start with what Marx referred to as the means of communication and transport. These means are the closest Marx comes to addressing a concept of media in his *oeuvre*, if we ignore his writings about journalism (de la Haye 1979; Fuchs 2009a). Examining what Marx wrote about the means of communication and transport extends the argument from chapter one that the commodity-owner is a vehicular prosthesis for the commodity and logistical support for value; by moving commodities to the market, the commodity's guardian is a means of transportation. For the purposes of argument, I initially treat Marx's concept of the means of communication and transport as synonymous with what I term capital's media even though the former more appropriately corresponds specifically to the sub-category of capital's transfer media—a point I elaborate in chapter six.

In *Capital Vol. 1*, Marx first mentions the means of communication in the context of the production of relative surplus-value and the division of labour in manufacturing. Arguing that the “number and density of the population” is a pre-condition for the division of labour within society, he writes that this density is relative because a thinly populated country with well-developed means of communication has a higher density than a populous country with poorly developed means of communication (Marx 1976:472-3). A geographic space inscribed with railways and asphalted roads on which vehicles move at technological speeds is smaller and has a higher population density than a territory of

comparable size with dirt roads on which beasts of burden pull carts. While he does not invoke the oft-cited phrase from the *Grundrisse*, Marx's introduction of the means of communication in *Capital Vol. 1* is thus based on their "annihilation of space by time" (1973:524).

In the chapter on machinery and large-scale industry, Marx discusses the means of communication and transport in terms that identify the position and functioning of these means as a category within his total system of categories and the social process of (re)production. We already know from my discussion of the guardian-as-vehicle that capital's media function to materially mediate the circulation (formal movement) of the commodity. Consequently, capital's media can consequently be positioned in the sphere and process of circulation as a category and in its material functioning. Both the means of communication and the circulation process are, however, nested within yet another category.

Hence, in the second mention of the means of communication in *Capital Vol. 1*, Marx, however, writes that "the revolution in the modes of production of industry and agriculture made necessary a revolution in the *general conditions of the social process of production, i.e. in the means of communication and transport*" (1976:505-6, emphasis added). For good measure, Marx reiterates this connection the next time he mentions the means of communication and transport (1976:579).⁶²

The formal position of the means of communication as a category is thus within the general conditions of production. This connection is important because Marx indicates that the means of communication change and develop with the general conditions as they adapt to revolutions in the mode of production. In other words, the general conditions of production indicate a theory of how capital's media change. But what are the general conditions of production? What is the function of these general conditions? What is the

⁶² The last mention of the means of communication and/or transport in *Capital Vol. 1* comes in the context of the general law of capitalist accumulation and in relation to the increasing productivity of labour (Marx 1976:773).

precise relationship between the general conditions of production and the means of communication and transport?

With general conditions of production, Marx is referring to infrastructure (roads, canals) (1973:526, 530), the means of communication and transport (1973:524; 1976:505-6, 579), but also to “exchange, buying and selling” (1976:652) and the world market (1976:474). In *Grundrisse*, Marx appears to identify the function of these conditions, writing that “[a]ll *general conditions of production*... facilitate circulation or... make it possible... or... increase the force of production” (1973:530-1). Limited to these phenomena and functioning, the general conditions would almost be synonymous with capital’s media considering, I argue, they physically mediate the circulation process of capital. Despite the similarity between them, the general conditions are not identical with the category of capital’s media and therefore cannot be reduced to the means of communication.

For example, Marx argues that “the colonial system and the extension of the world market” belonged to the general conditions during the period of manufacturing (1976:474). With reference to the period of large-scale industrial production, he argues that “coal-mining and iron-mining, the metallurgical industry” (1976:579), and production of machinery by machinery are also included in the general conditions (1976:506). In addition to the means of communication, the general conditions of production thus also include phenomena that concern politics and the state, science and technology, and production. That the means of communication and transport are not synonymous with but rather belongs to the general conditions of production, provides a clue to what capital’s media are and that although they function within and for the circulation process, this functioning is intimately tied to the process of production.

By belonging to the “general conditions of production” capital’s media are also general; it is, therefore, necessary to clarify what Marx means by “general.” Marx typically opposes general with particular, as in general human labour versus the particularities of concrete labour, or the general equivalent of money versus the particular equivalents found in the world of commodities. The general conditions of production must be

understood to be opposed to the “particular conditions for one capitalist or another,” such as the buildings, machinery, and inputs needed to keep production going (Marx 1973:531; 1976:510). The relationship between an individual capital and the general conditions is “of a specific relation of capital to the communal, general conditions of social production, as distinct from the conditions of a particular capital and its particular production process” (Marx 1973:533). What belongs to the general conditions of production is something that benefits (or impedes) all particular capitalist production processes. Infrastructure illustrates this distinction well: roads, canals or railways will benefit not just a single capital, but all individual capitals in a given area. In the aggregate, the market and circulation also benefit all capitals, given a certain mass and velocity of money available to circulate commodities.

In *Grundrisse*, Marx argues that the generality of these conditions of production is indicated by the large role the state plays in their construction as public works (1973:529-31). General conditions of production are materially necessary for the social process of reproduction but are unprofitable to produce privately (Altvater and Hoffman 1990:146-7). Marx argues that it is usually the state that develops the general conditions of production, in particular infrastructures like roads and railways. Such projects require simply too much capital, would take too much time to complete, and would, therefore, be too risky for any individual capitalist or even a joint stock company to undertake.⁶³ Only in exceptional circumstances, at the highest possible stage of development of the capitalist mode of production, will public works be done and paid for as private projects (Marx 1973:529-31). As Marx notes, however, at one point in the development of the

⁶³ Theorists like Dieter Läßle and Elmar Altvater argued, albeit with some differences, that the general conditions of production can be used to account for the necessity of the state as a separate institution (Holloway and Picciotto 1978:19; Altvater and Hoffman 1990:145). Given that capital can only exist as individual capital, the reproduction of capital as a totality—social capital—can only be ensured by an autonomized state. Individual capitals are mutually antagonistic, hence reproducing social capital requires the state to provide the necessities that individual capitals cannot provide. State functions are therefore “concerned with making good the deficiencies of private capital and with organizing individual capitals into a viable body” (Holloway and Picciotto 1978:20). A key state function, in addition to regulating the class struggle, is therefore the provisioning of the general conditions of production (Altvater and Hoffman 1990:148).

general conditions, they become privatized (1973:531; Dyer-Witheford 1999:207-8). For example, even though almost every maritime container port built in the US in the 1960s and 1970s were developed at the public's expense, they are run by private corporations for the purposes of generating private profits (Levinson 2006:238-9). Similarly, the state-developed internet now provides the basis for capital accumulation of businesses like Google and Facebook.⁶⁴

Broadly, the general conditions of production serve the reproduction and continuity of any and all capitalist production processes and as such the continuity of social capital, i.e. the aggregate of all independent circuits of capital. The implication is that capital's media, too, are general and communal, and serve all individual capitals rather than this or that particular capital. Given that the means of communication belong to the general conditions of productions, the general function of the former can be derived from the latter. In other words, the general function of capital's media must contribute to the functioning of the general conditions of production. But what is the function of the general conditions? To continue it is necessary to discuss the relationship between the general conditions of production and the mode of production in terms of how both change and develop. This relationship is also important to understand the reason for why and how capital's media change.

Marx argues that a revolution in one branch of industrial capital forces a transformation in other branches that "are connected together by being separate phases of a process, and yet isolated by the social division of labour, in such a way that each of them produces an independent commodity" (Marx 1976:505). Specifically, technological, scientific or organizational change that leads to increases in productivity in one branch of production leads to and requires chain reactions in other branches so that the new level of productivity in the original branch can be maintained. The close link between these various production processes means that a revolution in terms of knowledge, technology

⁶⁴ The privatization of the general conditions does not mean, however, that they cease to belong to these conditions.

and organization in one branch propagates throughout related branches, leading not only to growth in productivity, but also increased output, which in turn leads to new chain reactions throughout related branches of production and eventually to a revolution in the mode of production. The reason for the chain reactions among related branches of production is that they are connected through their circulation processes because they supply each other with raw materials, means of production, and other necessary commodities.

Marx provides the example of the revolution in cotton-spinning that “called forth the invention of the gin” because only then could the production and thus the supply of cotton keep up with the productivity of mechanized cotton-spinning (1976:505).⁶⁵ A more contemporary example is the emergence of the standard shipping container and the container ship. First, the standard container led to the production of ships that were designed to carry only containers. Second, the container ship required the rebuilding of ports to handle containers and invention of new shore side equipment, in particular, faster, bigger and farther reaching gantry cranes to lift containers and keep up with the volume of cargo the new container ships could move (Cudhay 2006:94-5; Levinson 2006:245).

The impetus for the means of communication and transport to change, therefore, comes from revolutions in other branches of production. Marx, however, argues specifically that the means of communication and transport are revolutionized in step with the mode of production because this, in turn, requires that the general conditions of production also change. Hence, we are again operating at the level of general conditions and not those of individual capitalists.

Marx argues that the generalization of production with machinery led to a change in the way of production from manufacture to large-scale industry and a resultant dramatic increase in output that in turn required changes to the general conditions of production;

⁶⁵ A cotton gin is a machine that separates seeds from the cotton fiber. Previously this separation was done by hand.

Marx, however, pays particular attention to how the means of communication and transport must become *adequate* to the new mode. Tracing the changes in the means of communication through three different periods of the capitalist mode of production, Marx writes that

the revolution in the modes of production of industry and agriculture made necessary a revolution in the general conditions of the social process of production, i.e. in the means of communication and transport. In a society whose pivot... was small-scale agriculture, with its subsidiary domestic industries and urban handicrafts, the means of communication and transport were so *utterly inadequate to the needs of production in the period of manufacture*, with its extended division of social labour, its concentration of instruments of labour and workers and its colonial markets, that they in fact became revolutionized. In the same way *the means of communication and transport handed down from the period of manufacture soon became unbearable fetters on large-scale industry, given the feverish velocity with which it produces, its enormous extent, its constant flinging of capital and labour from one sphere of production into another and its newly created connections with the world market*. Hence, quite apart from the immense transformation which took place in shipbuilding, the means of communication and transport gradually adapted themselves to the mode production of large-scale industry by means of a system of river steamers, railways, ocean steamers and telegraphs” (Marx 1976:505-6, emphasis added).

There are a few salient points to draw attention to in this passage that is relevant for delineating the concept of and a theory of capital’s media. First, changes in production, particularly in the speed and volume, and scope and scale of its output, require changes in capital’s media system or else it will remain a fetter on the mode of production in the sense that it cannot be adequately reproduced.

Second, it follows that capital’s media must be able to absorb (i.e. transfer, store, and process) commodities in the quantity and speed (or according to the schedule) with which they are produced. That is, to be appropriate or adequate to the mode of production, the means of communication must have sufficient capacity and move at a speed according to the input and output requirements of production. As de la Haye argues, the mode of production requires “regular, fast, and dependable systems of supply and distribution” (1979:15), and, as Marx observed, in the period of large-scale industry, these adequate systems were steamships, railways, and telegraphs (1879; 1976:506).

Third, Marx is not pointing to any individual medium, but rather media systems (such as railways) and an assemblage of different media systems as what must be in place for unfettered production. This attention to systems is an important point for a theory of capital's media. All of the concrete media that I discuss in part two of this dissertation are systems that consist of various components; intermodal transportation, distribution centers, and point-of-sale (POS) systems form a total system without which the current period of logistical capitalism would not be possible.

Fourth, as I indicated in the previous chapter, the system of river and ocean steamers, railways, and telegraphs Marx describes is nothing but a remediation of the logistical support the guardian-as-vehicle provides for value in the opening to Chapter Two. The case studies or examples of capital's media that I discuss in part two were therefore selected because they are adequate to so-called post-Fordism, flexible accumulation, or what I prefer to call "logistical capitalism" that emerged in the 1970s.

Fifth, based on the notion of "adequacy to the mode of production," the general function of capital's media is to reproduce capital. This function is, however, too broad and does not distinguish media from the other general conditions of production. To proceed, it is necessary to explore the general conditions further to situate media in the social process of (re)production.

When the means of communication and the broader general conditions of production are adequate to a period of the mode of production, "*this mode of production acquires an elasticity, a capacity for sudden extension by leaps and bounds*" (Marx 1976:579, emphasis added). Marx also argues that continuity is a "characteristic feature of capitalist production" (1978:182). In *Capital Vol. 2*, Marx specifies that continuity of capital is tied to the reproduction of the production process (1978:182-184, 219). Given that the reproduction of production occurs with and through circulation—indeed they are near synonymous—the continuity of capital is dependent on a circulation process that is as smooth and friction-free as possible.

The production process cannot be begun anew before the transformation of the commodity into money. The constant *continuity of the process*, the

unobstructed and fluid transition of value from one form into the other...
 appears as a fundamental condition for production based on capital...
 (1973:535).

Marx makes this argument in the context of discussing “transport to the market” and how circulation proceeds in space and time (1973:533-4). The continuity and reproduction of production are thus dependent on the continuity of circulation, i.e. on an as fluid metamorphosis of capital as possible. Capital’s media contribute to making the circulation of capital fluid; for example, the function of going to market that the guardian carries out as the commodity’s vehicular prosthesis is necessary for the unobstructed and fluid metamorphosis of value.

The function of the means of communication as part of the general conditions of production is to contribute to the continuity of capitalist production by making the circulation process as fluid as possible. By virtue of this function, capital’s media contribute to giving the mode of production elasticity. It is with reference to the continuity of capitalist production that the general function of capital’s media can be identified as contributing to the elasticity that the general conditions afford production. And in general, the elasticity is tied to the scale and scope of capital, or, what nearly is the same, the speed and volume of production (de la Haye 1979:14-6; Dyer-Witheford 1999:207). Whereas elasticity was connected to the “feverish velocity” and “enormous extent” that characterized large-scale industrial production (and arguably also Fordism), in the age of logistical capitalism, this elasticity should be understood as “flexibility.” I return to this flexibility in the introduction to part two.

That I position the category of the means of communication and transport within the sphere of circulation and as something that functions for the circulation process requires further discussion. Marx considered communication and transportation to be a branch of production involved in “moving commodities and people” in the case of transportation and “the transmission of mere information—letters, telegrams, etc.” in the case of the broader communications industry” (1978:134). Being a branch of social production, the means of communication involved in producing the useful effects of moving commodities and transmitting information are machinery—fixed capital that belongs to

the sphere of production and function to produce relative surplus-value. In other words, the means of communication and transport are means of production (Williams [1978]2005:50-63; Hebblewhite 2012). Indeed, Marx introduces the means of communication next to the means of production and in the chapters concerning the production of relative surplus-value in *Capital Vol. 1* (1976:290-1, 473, 506). In *Capital Vol. 2*, he clarifies that the particular use-value these means help to produce is a unique “change in spatial location” and that although this commodity can only be consumed as it is produced, the value of this “useful effect is still determined, like that of any other commodity” (1978:134-5, 227).⁶⁶ Arguing that the means of communication (and by extension capital’s media) belong to the sphere of circulation, therefore, appears to be a categorical mistake.

Here it is necessary to reiterate a salient point about the circulation point of view, namely that communication and transport has a “two-fold” (Parker 1981:138) or liminal status within Marx’s political economy. As he writes in *Capital Vol. 2*:

The ‘circulating’ of commodities, i.e. their actual course in space can be resolved into the transport of commodities. The transport industry forms on the one hand an independent branch of production, and hence a particular sphere for the investment of productive capital. *On the other hand it is distinguished by its appearance as the continuation of a production process within the circulation process and for the circulation process*” (1978:229, emphasis added; see also 1981:379).

From the vantage point of circulation, the means of communication function within and for the circulation process. Moreover, from this vantage point, what is the fixed capital of machinery in production becomes capital’s media in circulation. The precise categorical position of capital’s media is therefore tied to fixed capital (machinery) but as it functions within the circulation process. Fixed capital is thus the categorical touchstone for capital’s media: it splits into machinery (production) and media (circulation), and between them, there is a liminal blurring.

⁶⁶ The value of the commodity of the transportation branch of production is, in other words, determined by the duration of the (socially necessary) labour that went into producing it.

In *Grundrisse*, Marx makes what is perhaps his clearest circulationist statement about the means of communication and transport, referring to them as “the physical conditions of exchange” and arguing that because “[c]apital by its very nature drives beyond every spatial barrier” the creation of these physical conditions due to their “annihilation of space by time” becomes an “extraordinary necessity” (1973:524).⁶⁷ In addition to indicating that the means of communication belong to circulation in the overall process of social reproduction, this particular argument by Marx speaks to the particular media function of “transfer” or an overcoming of space as elaborated by Canadian-German media theory (Kittler 1996). In other words, the concept of the means of communication and transport refers exclusively to the particular category of capital’s transfer media. Considering that media theory operates with the additional functions of storage and transfer, Marx’s category of the means of communication and transport cannot be synonymous with the category of capital’s media.⁶⁸

I discuss and develop the general and particular functions of capital’s media starting from chapter three onwards. At this juncture the following definitions of capital’s media can be made: they belong to and form part of the general conditions of production but as the physical conditions of circulation. The formal position of capital’s media as a category, and in terms of its functioning in the social process of production, is therefore in the general conditions of production, but specifically in the sphere of circulation as the mirror of machinery or the circulatory mode of appearance of fixed capital. Based on the previous chapter’s discussion, the general function of capital’s media is to materially mediate, i.e. physically condition, the formal movement of C—M—C to ensure that it is

⁶⁷ Later in *Grundrisse* Marx uses circulation as a synonym for exchange, so that the means of communication are the “physical conditions of circulation” (1973:533). In *Grundrisse*, Marx makes only two references to the physical conditions of exchange; on the same page and both times clarifying these as the means of communication and transport (1973:524). I have found no references to these physical conditions in *Capital*, Vols. 1-3. I have not, however, had the opportunity to search the *Marx-Engels Collected Works* or the *Theories of Surplus Value*.

⁶⁸ Although Marx did discuss storage next to transportation in *Capital Vol. 2*, he was not a media or communications scholar and therefore could not view, like Canadian-German media theory does, storage as complementary to transportation.

as fluid or friction-free as possible. As part of the general conditions of production, this material mediation is either inadequate or adequate to the mode of production. If inadequate, capital's media function as a fetter. But if they are adequate, capital's media give the mode of production elasticity to expand in leaps and bounds.

In part two, I discuss the cases of intermodal transportation, distribution centers and point-of-sale systems as media that are adequate to the logistical requirements of contemporary logistical capitalism. But how is production organized in this period? Despite the circulationist approach of this dissertation, it is necessary to discuss production because capital's media belong to the general conditions of production. While this discussion is somewhat of a detour in the formal analysis of capital's media as a category, it will help us better understand the place of capital's media in the general conditions of logistical capitalism and therefore ground the discussions of the three chapters in part two. What I argue in the following sections is that the paths of capital's movement are set by the spatial arrangement of production in supply chains, but that this spatial arrangement is determined by the formal movement of capital through the circuit of capital; it does not merely go to market as a commodity but also goes to the factory and passes through the sphere of production.

2.2 The supply chain and logistics

In the current period of the capitalist mode of production, production is outsourced and organized into global supply chains around just-in-time (JIT) production schedules, relying on information collected at the point of sale (POS) as corrective feedback in order to produce, distribute and exchange the commodity at the right time and place, and in the right quantity (Harvey 1990; Lynn 2005; Li 2007; Levinson 2006; Bonacich and Wilson 2008; Bernes 2013; Cowen 2014a). Drawing on the analysis of other Marxist scholars (Ashton 2006; Bonacich and Wilson 2008; Starosta 2010; Bernes 2013; Toscano 2011; 2014; Cowen 2014a; 2014b; Manzerolle and Kjøsén 2014), but in particular on Anna Tsing's (2009) argument that we are living in an age of "supply chain capitalism", I argue that the current period of the capitalist mode of production can be qualified as "logistical" due to the increased centrality of logistics to business since the 1970s (Ashton 2005;

Bonacich and Wilson 2008:3; Christopher 2011:2; Cowen 2014a:23-5). I now discuss the supply chain and logistics in turn.

The supply chain as a concept is relatively recent despite the fact that businesses have always worked with suppliers and customers, and arguably “extend[s] back in various forms as far as trade itself” (Tsing 2009:149).⁶⁹ David Blanchard dates the term to the 1950s and identifies it with Jay Forrester’s research on the “bullwhip effect” in “supply pipelines” (2010:6-7). The corporate supply chain has its pre-history in the military and colonial “supply line” and in the preceding civilian concept of the “cold chain” (Cowen 2014a:9; Klose 2015:179). But how is the contemporary supply chain defined? In the business literature, the definitions of the supply chain can be divided based on their respective focus on the supply chain’s constituent parts or its temporality.⁷⁰

As a process in time, the supply chain is defined as a “sequence of events” or “chain of activities” in the flow of goods or the life cycle of a given product; these events include the various steps in making and moving a product to the market, and thus refer to activities such as design, production, transportation and warehousing which are linked in a timely manner (Hugos 2003; Lynn 2005; Emmet and Crocker 2006; Branch 2009; Blanchard 2010; Christopher 2013). In terms of its constituent parts, the supply chain is understood as being made up of an operational alignment between a company, its suppliers, customers and the supporting distributive and supplier networks that together form so many links in a particular chain (Vitasek n.d., 186; Branch 2009; Bowersocks et. al. 2012:v; Christopher 2013). Cowen (2014a) stresses that the supply chain includes infrastructure, and so considers ports, highways, railways, trade corridors and gateways (e.g. ports), and even securitized stretches of open water to be constituent parts of a

⁶⁹ See Hopkins and Wallerstein (1986) for a discussion on “commodity chains” in the world economy prior to the 1800s.

⁷⁰ There is no single definition of the supply chain and one definition will stress different characteristics from the next. Some even dispute the very term ‘supply chain’, arguing that ‘demand network’ is a more appropriate concept today (see e.g. Christopher 2011:4).

supply chain.⁷¹ Materially the links are therefore made up of factories, transportation networks and vehicles, warehouses and distribution centers, retailers and the end customer(s).

While I agree with the temporal definition of the supply chain, when it comes to its constituent parts I include only the sites of production and exchange that are linked to a particular network of suppliers and customers. Hence, whereas the supply chain consists of factories, retail stores, and end customers, phenomena like infrastructure, vehicles, and distribution centers are examples of capital's media. To explain the importance of capital's media to the supply chain, I draw on a recent Marxist approach (Ashton 2006; Tsing 2009; Starosta 2010; Cowen 2014a; 2014b; Toscano 2014) to the supply chain that argues it is the new form of the factory and that commodities are no longer produced at singular sites, but in geographically long and sprawling production networks that started emerging in the 1970s due to the phenomena of outsourcing, subcontracting, and the disintegration of the Fordist factory.⁷²

⁷¹ Cowen specifically refers to the International Recommended Transit Corridor (IRTC) in the Gulf of Aden. Situated close to the Suez Canal and Somali coastline, the IRTC is a special zone of security and subject to intense naval policing in order to keep the circulation of capital going (Cowen 2014a:129-61). The IRTC can be viewed as a 'political component' of the general conditions of production of logistical capitalism and as such similar to the colonial system of the period of manufacturing. While he does not refer to the general conditions, Zoltan Glück argues perceptively that "counterpiracy resembles an infrastructural project similar to railroads or highways, taken up here by state bursaries in the general interest of the capitalist class" (2015:13).

⁷² While this approach arguably started with Brian Ashton's (2005) autonomist-inspired argument that the supply chain is the social factory, it is Cowen (2014a) that stressed the stretched factory thesis. This focus on the supply chain as a factory does, however, has its antecedent in the earlier neo-Marxist global commodity chain (GCC) (see Wallerstein and Hopkins 1986; Gereffi and Korzeniewicz 1994; Bair 2009) or global production network (GPN) (Henderson et. al. 2002) approaches. While the supply chain and logistics have been neglected by Marxists until quite recently, an exception is the autonomist Marxist Sergio Bologna who argued for their increasing importance as early as the 1970s. Against other autonomists that equated post-Fordism with the advent of immaterial labour and cognitive capitalism, he argued that the "key networks that condition contemporary capitalism are neither affective or simply digital, but involve instead the massive expansion and constant innovation in the very material domain of logistics" (in Toscano 2011:n.p.). Unfortunately, Bologna's short writings on logistics from the 1970s have yet to be translated into English, but for a few fragments appearing in various articles by Alberto Toscano (2011; 2014).

According to Cowen, “production... has been systematized, broken into component parts, and distributed into complex geographical arrangements. The factory is superseded by the supply chain; the factory is now ‘stretched’ across a highly uneven economic and political geography” (2014a:183-4).⁷³ The supply chain has thus replaced the vertically integrated factory. If Ford’s Baton Rouge complex exemplifies the apotheosis of vertical integration, the supply chain represents its end and disintegration (Lynn 2005:17).⁷⁴

Like the supply chain, logistics is a relatively recent concept although it has a long history as a martial art of moving soldiers and continually supplying them with both means for living and taking life at the right time and place (Bonacich and Wilson 2008:3; Cowen 2014a:24). This underlying principle of managing the flow of materials to meet the requirements of an army is still the same (Van Creveld 1977; Lynn 1993; Christopher 2011:1). It is only recently that businesses have come to recognize the importance of logistics; although the foundations for the logistics revolution were laid in the 1970s, it was in the 1980s that companies first started to view logistics as a “core competency,” and not until the mid-1990s that giant global logistics companies emerged and the sector

⁷³ The new division of labour represented in the stretched factory of the supply chain makes it possible to exploit the highly uneven global political and economic geography in terms of wages, social protections, labour regulations, the size of the industrial reserve army, and so on (Ashton 2005; Tsing 2009:151; Bernes 2013; Cowen 2014a:102-3, 184; 2014b; Toscano 2014). As Jasper Bernes argues, “planetary supply chains... effectively encircled labour, laying siege to its defensive emplacements” (2013:n.p.). Unions and worker militancy can be avoided and/or effectively fought by deciding to source supplies elsewhere or re-route capital around high-waged and/or recalcitrant labour. The general trend since the 1970s is that real wages have fallen, employment is increasingly precarious, workers are increasingly surveilled and policed, and manufacturing conducted in the global south by feminized and racialized others (Harvey 1990; 2006; Dyer-Witthford 1999; 2015; Collins 2003; Bonacich and Wilson 2008; Cowen 2014a). Working class activity, particularly at potential chokepoints such as ports, are subject to increased surveillance, policing, and violence (Cowen 2007; 2009; 2014a; Glück 2015).

⁷⁴ Despite this disintegration, and the distances and different legal jurisdictions involved, supply chains are so tightly interconnected that it has become increasingly hard to tell one company from the next; vertical integration has given way to virtual integration (Hugos 2003; Christopher 2011:13, 142-44). The best example of this new type of integration is represented by companies—retailers like Wal-Mart and so-called “design” companies like Dell and Apple—that “trade in the production of others” (Lynn 2005:10).

saw tremendous growth (Ashton 2005; Bonacich and Wilson 2008; Christopher 2011:2).⁷⁵

The relationship between the supply chain and logistics can be explained as the former being the paradigmatic space of or the strategic framework in which logistics occurs and is a subset (Bowersocks et. al. 2012:4; Cowen 2014a:8). In other words, the activities I listed as belonging to the temporality of the supply chain are logistical. Some of these logistical activities—in particular, transportation, storage, ordering, and sales—are phenomena that can be analyzed from the point of view of circulation and regarding how they link points of production to each other and points of exchange. Importantly, these logistics activities are dependent on capital’s media.

While there is no one single definition of logistics, the business literature appears to discuss it in terms of how it links or synchronizes the supply chain. With a geographically dispersed factory, logistics serve to link factories, plants, the distribution network, and the marketplace into a continuous process through specific logistics activities (Bowersocks et. al. 2012:4; Branch 2009:1). This linking is inherently tied to the synchronization or scheduling of the movement of products and information between members of a supply chain and is, therefore, dependent on an increase in transport and communication processes (Klose 2015:ix). Logistics, therefore, refers to the movement and geographical and time-related positioning (i.e. storage) of resources in order to ensure that they are at the right time and place, and in the right quantity (Bowersocks et. al 2012:v, 4; Lai and Cheng 2009:4; Branch 2009:1)

Both Cowen (2014a) and Enda Bonacich and Jake B. Wilson (2008) refer to a revolution in logistics. According to Cowen, this revolution was primarily about the “calculation and organization of economic space” that offered a “new logic for how, and so *where*, to do business” (2014a:23). This new logic was a consequence of the introduction of systems

⁷⁵ Commenting on an argument Mark Shaw made in 1915, that companies should pay more attention to the physical distribution of goods and the question of supply, Martin Christopher observes that it is “paradoxical that it has taken almost 100 years for these basic principles of logistics management to be widely accepted” (2011:2).

thinking into the separate spheres of production and distribution in the 1960s. Whereas the latter used to be understood as a discrete operation following the former, with systems thinking the two were considered to be part of a unified system in which the fluidity and total cost of the system became the focus rather than maximizing efficiency in separate departments (Cowen 2014a:36-8; Klose 2015:168).⁷⁶ The logic of total cost had a profound impact on the spatial arrangement of production because

transportation [was] conceptualized as a vital element of production systems rather than a separate domain or the residual act of distributing commodities after production; it thereby put the entire spatial organization of the firm, including the location of factories and warehouses directly into question (Cowen 2014a:40).⁷⁷

The logistics revolution, therefore, leads to a “dramatic recasting of the relationship between *making and moving* or production and distribution” (Cowen 2014a:103).

Toscano (2014) and Bonacich and Wilson (2008:3) concur and argue that because these phenomena are viewed as a single unit, they are separable only analytically. In other words, they view transportation as an integral part of the stretched factory.

With her focus on the logic of total cost and the spatial arrangement of production, Cowen effectively argues that the logistics revolution was a presupposition for the emergence of global supply chains. Bonacich and Wilson, however, argue that this revolution was a consequence of the increasing necessity of coordinating “complex, sprawling, ever-changing supply networks” (2008:14).⁷⁸ In their analysis they note that

⁷⁶ In operations research, optimizing a system means “finding the best possible combination of elements rather than trying to maximize the performance of each individual element. To achieve this, optimization strategies analyzed the interplay of all elements and then concentrated on the bottlenecks, the elements that curbed the overall achievement of the system” (Klose 2015:204-5).

⁷⁷ Cowen explains that total cost analyses had this impact on the spatial arrangement of production because they “would often yield counterintuitive decisions regarding location” such as locating production or distribution facilities further away from consumers in order to increase profits (Cowen 2014a:38, 104).

⁷⁸ The logistics revolution, however, is also a result of the changed economic-political environment since the 1970s, in particular the rise of neo-liberalism and its concomitant deregulation (especially in transportation), attacks on the welfare state, and increased international free trade (Bonacich and Wilson 2008; Cowen 2014a; Klose 2015; see also Harvey 1990).

until recently, logistics was limited to transportation and warehousing, but after the logistics revolution it has come to refer to “the management of the entire supply chain, encompassing design and ordering, production, transportation and warehousing, sales, redesign and reordering” (Bonacich and Wilson 2008:3).⁷⁹ In this context, “manufacture is merely one moment in a continuous, Heraclitean flux: the factory dissolves into planetary flows” (Bernes 2013:n.p.).

Some of the core concepts of the logistics revolution were derived from Toyota’s just-in-time (JIT) production system (see Ohno 1988; Womack, Jones and Roos 2007). This production philosophy is oriented around the concept of “continuous flow” and views anything that is not in motion, in particular, inventory as waste; according to Bonacich and Wilson, uninterrupted flow “is the idea behind the logistics revolution” (2008:15). At no point in the commodity’s movement from point of production to sale should it wait idle for further processing; the flow from one link in the chain to the next, from ordering to production, shipping and sale should all occur in one single smooth motion and just-in-time (Lai and Cheng 2009; Bernes 2013:n.p.). For Bernes, JIT is a circulationist production philosophy that signals the submission of “all production to the condition of circulation” (2013:n.p.).

While I largely agree with arguments that the supply chain is the new form of the factory, that the distinction between making and moving has dissolved, and that logistics is primarily concerned with flow, these arguments are primarily couched in terms of production. While Cowen recognizes the importance of circulation, considers the stretched factory to be a “network of production and circulation” (2014a:11), and even argues that “the productive capital of the transport and communications industries” is what “bring us closest to thinking about the materiality of circulation”, she nevertheless emphasizes the productive point of view by stressing that the supply chain is a factory (2014a:101, 100-5). In addition, the proponents of the stretched factory thesis couch their

⁷⁹ Since the mid-1990s, logistics has increasingly referred to as supply chain management (Bonacich and Wilson 2008:3; Klose 2015:178).

argument only superficially in Marx's analysis of the production process and the factory and therefore cannot explain, from a value theoretical point of view, why "flow" has become increasingly important.⁸⁰

Using the factory as the core analytical concept with which to conceptualize the supply chain is misplaced because it elides circulation. I argue that the circuit of capital, which stresses the unity of production and circulation, is a better concept with which to conceptualize the supply chain. Indeed, relying on the circuit of capital is necessary because I want to stress the analytical distinction between making and moving, and that transportation—and more broadly logistics and the media it is dependent on—occurs within and for the circulation process. More specifically, I argue that the supply chain should be understood as the material content of the circuit of capital.⁸¹ In order to proceed, it is necessary to pick up where I left the analysis in chapter one and introduce the circuit of capital.

2.3 The circuit of capital

In chapter one, the analysis of the relationship between movement and value left off with the argument that value's being is the formal movement whereby a commodity transforms into money and back again (C—M—C), and that the force or engine behind

⁸⁰ Superficial in the sense that they use terms like surplus-value, exploitation, the factory, division of labour and so on, but do not interrogate these terms or consider how Marx's analysis of the production process must be critiqued and updated to fit this new paradigm for the factory. Even Bernes, who stresses circulation more than Cowen, does not consider Marx's analysis of the circulation process in much detail.

⁸¹ In other words, I argue for the form-analysis of the supply chain. Whereas the factory is the content of the sphere of production, the material activities of logistics form the content of the sphere of circulation. To my knowledge, Guido Starosta's (2010) critique of the global commodity chain (GCC) paradigm is the only attempt that comes close to a form-analysis of the supply chain. He argues that the supply chain is a concrete mediation of the law of value and the concrete form taken by competition among capitals, but is confusingly also the social form through which "normal capitals" appropriate surplus-value from "small capitals" (Starosta 2010:450-1). The problem with this analysis is that Starosta does not develop his argument as a movement from the abstract to the concrete; he starts off his analysis with prices and profit rather than on the level of abstraction of value. Moreover, he jumps between different levels of abstractions willy-nilly, does not explain the relationship between social and natural form, confuses a thing (the supply chain) for a social form, but nevertheless attaches the social function (regulation of competition) to the supply chain as thing.

the movement of things and people in the capitalist mode of production is the immanent contradiction of the commodity. The analysis thus stopped right before introducing capital as a social form.

Marx argues that the circulation of capital describes a “characteristic and original path... different in kind from” the circulation of commodities (Marx 1976:248). In the previous chapter, the path that was traced was that of value moving through the sphere of circulation as a change of form from commodity into money and back again. The movement of capital is, however, about the quantitative expansion of value, i.e. the production of surplus-value. That is, money cannot merely mediate the circulation of commodities, but must instead become the *telos* of circulation (Marx 1976:255). The reason why capital in its movement must take an original path is that no new value can be created in circulation; all that happens is that value is redistributed and posited in its form(s). Capital’s original path must, therefore, take it where new value can be created. Although capital cannot arise from circulation, it is “equally impossible for it to arise apart from circulation. It must have its origin both in circulation and not in circulation” (Marx 1976:268).⁸² The original path taken by capital leads to the factory, that “hidden abode of production” where capital assumes the form of a production process (Marx 1976:279). In other words, capital must, as Nick Gray argues, “*externalise* itself in the material world of production through the exploitation of labour-power” (Gray 2010:n.p.).⁸³

⁸² More specifically, Marx develops the category of capital from the money form; the former gives the latter’s contradiction a room in which to move by externalizing it into the opposition between circulation and production. Alternatively, this argument can be understood as Marx “doubling” circulation into the contradiction between circulation and production. Whereas Marx characterized circulation as a formal metamorphosis of form, production is a process of real metamorphosis whereby the elements of production are transformed into qualitatively new commodities impregnated with surplus-value. In other words, the commodities purchased in stage one are altered both materially and in value. A qualitatively new commodity should be understood as a commodity with a different use-value. Indeed, the creation of a new use-value is necessary for surplus-value to be objectified in the commodity.

⁸³ As Gray (2010:n.p.) adds, this movement subsumes production under the value form (i.e. capital). Production is thus form-determined as the valorization process of capital.

By externalizing itself in production, capital effectively subsumed the circulation of commodities into its own movement. The formal movement of capital is, therefore, $M—C (Lp+Mp)…P…C'—M'$: a quantity of value in money form (M) is advanced as capital to purchase the commodities (C) of labour-power (Lp) and means of production (Mp), in order to produce (P) commodities with surplus-value (C') that can be sold for more money (M) than was originally advanced. Marx describes capital as a quantity of

value that passes through a sequence of connected and mutually determined transformations, a series of metamorphoses that form so many phases or stages of a total process. Two of these phases belong to the circulation sphere, one to the sphere of production. In each of these phases the capital value is to be found in a different form, corresponding to a different and special function. Within this movement the value advanced not only maintains itself, but it grows, increases its magnitude. Finally, in the concluding stage, it returns to the same form in which it appeared at the outset of the total process. This total process is therefore a circuit (Marx 1978:132-3).

Figure 1 depicts the circuit of capital and shows how capital is a unity (or contradiction) of the spheres of production and circulation; of the three stages (or individual movements) of purchase ($M—C$), production (P), and sale ($C'—M'$); and of the three forms of money capital (M), productive capital (P), and commodity capital (C'). Capital, or more precisely a quantity of “capital value,” moves through the circuit by a representative of capital executing the function associated with each economic form, which allows capital to assume the next economic form and proceed to the next stage of the circuit.⁸⁴ The contradiction between production and circulation is resolved, and capital's unity is maintained, through movement (Marx 1978:109-43; Arthur 1998:102; Murray 1998:34, 44).⁸⁵

⁸⁴ More specifically, capital is a “moving contradiction” (Marx 1973:706). That is, each of capital's forms are characterized by “internal deficiencies, each of which is provincially overcome in the transition to the subsequent form of value” (Gray 2010:n.p., see also Endnotes 2010:71).

⁸⁵ What makes the forms of money and commodity and their respective social functions into particular forms and functions of capital is “their specific role in the movement of capital, hence also the relationship between the stage in which they appear and the other stages of the capital circuit” (Marx 1978:112). Money is capital only insofar as it is the possibility of transforming into commodities, which becomes productive

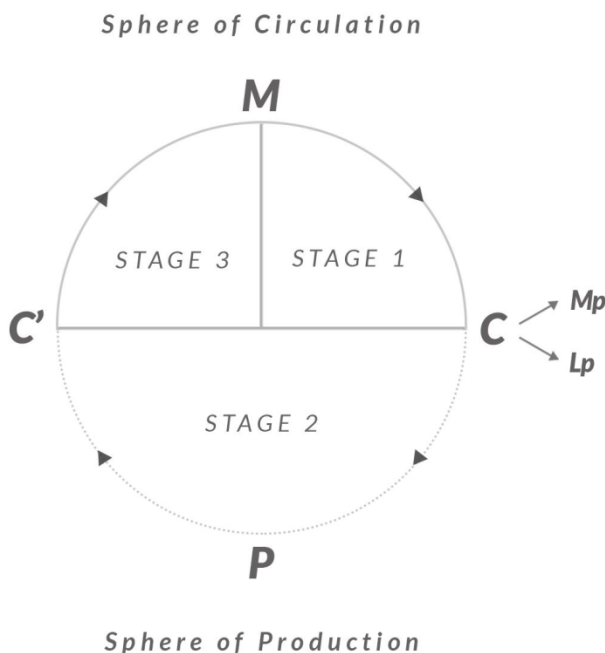


Figure 1: The circuit of capital

By advancing money as capital to purchase the means of production (Mp) and above all else the labour-power (Lp) commodity with its unique use-value of being a source of value greater than its own, the quantity of capital advanced is transformed into commodities with the natural form required for a particular production process.⁸⁶ It is not necessary to rehearse that the surplus in surplus-value comes from the wage-labourer working over and beyond the time required to reproduce what she is paid as a wage and therefore that surplus-value is unpaid labour time; and that increasing the rate of surplus-value/exploitation is done absolutely by extending the working day or relatively by altering the respective lengths of the working day through co-operation (i.e. forms of

capital during production that in turn bears the latent possibility of becoming commodity capital, i.e. commodities impregnated with surplus-value (Marx 1978:112, 158).

⁸⁶ In the hands of the capitalist, these commodities respectively represent the variable and constant components of his capital.

organization), intensifying the division of labour, or through the application of machinery (Marx 1976:283-654). The result of production is a number of qualitatively different commodities impregnated with surplus-value, i.e. commodity capital. This commodity capital must go to market, perform exchanges, and turn into money in order to realize the surplus-value created in production; this movement to the market is accomplished with logistical activities like transportation and storage and is dependent on capital's media. The sphere of circulation is, therefore, the sphere of logistics in addition to exchange, buying, and selling. When at least a part of this surplus-value is advanced to purchase the elements of production, capital is accumulated, which should be understood as the accumulation of both a quantity of value and capitalist social relations.⁸⁷

The circuit of capital describes both a formal movement of abstractions and a vibrant material process that unfolds in space and time, i.e. a purposeful movement of matter at a given speed. Each moment of the circuit is occupied by sensuous-concrete things (or activities), and each stage of the circuit is, with some exceptions, completed by the material movement of these objects.⁸⁸ In sum, Marx argues that when capital assumes a particular economic form, it also assumes a particular material form and that the movement of this matter is a necessary support for capital's (abstract/formal) being. With

⁸⁷ In the circuit of capital, that labour-power and means of production are bought separately and then brought together in the sphere of production indicates the existence of the "doubly free" worker as a condition for the entire movement of capital. With "doubly free", Marx refers to individuals being formally free to dispose of their labour-power as their own commodity, but are the same time being free from owning any means of production and therefore have no other commodity but their labour-power to sell (1976:272-3). Hence, in the circuit the movement $M-C (Lp+Mp)$ or more precisely that this movement is really the two separate movements of $M-Lp$ and $M-Mp$ confirms that capitalist social relations requires the separation of labour-power from means of production; accumulation is thus a repeated validation of the original act of so-called primitive accumulation.

⁸⁸ In some cases, as I discussed in the conclusion to chapter one, things can circulate formally without materially moving, although in the cases of the house, and the warehoused cotton and pig-iron, documents that are the property titles to these things move instead.

the circuit of capital being the unity of these forms, I argue that the supply chain is its content, i.e. natural form.⁸⁹

Although the concept of the supply chain did not exist at Marx's time, individual businesses had to and did operate with a network of suppliers and customers, which is something Marx was intimately familiar with as is revealed by the overtly logistical *Capital Vol. 2*.⁹⁰ It is from his analysis of the circulation process that it becomes clear that Marx arguably thought in terms of what we today would call a supply chain. For example, he writes that the continuity of production “depends on various conditions which essentially all derive from the greater speed, regularity, and certainty with which the necessary mass of raw material can be constantly supplied in such a way that no interruption arises” (1978:219).

The circuit of capital cannot, however, be reduced to the supply chain; the latter refers to a network of interconnected businesses, while the former represents either an “independent circuit of an individual capital” or to the aggregate of all circuits, i.e. social capital (1978:110, 177). In *Capital Vol. 2*, however, Marx argues that any individual circuit “presupposes in its description the existence of another industrial capital” that functions either as a seller of means of production or as a customer that purchases the commodities of the circuit in question (1978:176).⁹¹ Any individual circuit points beyond its own isolated existence; different capitals in different branches of production posit each other as presupposition and condition (Marx 1973:517; 1978:178). The circuit made by an individual capital is “intertwined” with other circuits because it “performs its own

⁸⁹ I argue that the relationship between the circuit and the supply chain should be thought of as the latter being the content of the former in the same way that use-value is the content of the commodity.

⁹⁰ The book starts with Marx describing capital in terms of the problems of sourcing the elements of production, the distribution of newly produced commodities, and later discusses the classical logistics activities of transportation and warehousing.

⁹¹ In other words, the “material conditions of commodity production confront him to an ever greater extent as the products of other commodity producers, as commodities” (Marx 1978:119).

circuit within the general circulation of commodities” (Marx 1978:139).⁹² With general circulation, Marx refers to the open market where one capitalist may buy commodities from a particular supplier one day and from another the next day.

By forming a supply chain, however, two or more individual capitals integrate their independent circuits through *aligning* their circulation processes; for example, by circuit A repeatedly purchasing means of production produced as commodities by circuit B.⁹³ With aligned circulation, capitals are thus connected through the circulation of particular commodities that an upstream supplier sells and a downstream supplier buys.⁹⁴ The circuit of capital and the supply chain are analogous or have a form-analytic relationship only if their relationships are understood as the supply chain integrating at least two circuits of capital in this manner.⁹⁵

⁹² The movement of an individual capital is therefore partial because completing this movement is dependent on and conditioned by other partial movements of individual capitals.

⁹³ When independent capitals have integrated their circuits by aligning their circulation processes, the movement of their individual capitals is no longer performed within the general circulation of commodities.

⁹⁴ Hence, it is not the “form of the act” (i.e. exchange of commodities) but rather “the material content, the specific use character of the commodities that change place with money” that aligns the circulation processes and thus integrates their circuits of capital into a supply chain (Marx 1978:110). In other words, if you are making linen coats, you do not buy just any commodity, but linen, as raw material. A good example of such aligned circulation is found in the tiers of suppliers in Toyota’s just-in-time production system where suppliers are long-term members in the auto maker’s supply chain (Womack, Jones and Roos 2007:149). The company assigns a whole component, such as a seat, to a first tier supplier that is in charge of delivering the complete component. This Tier-1 supplier will have a set of second tier suppliers of independent companies that produce the parts for the seat the first tier assembles. In turn the Tier-2 supplier may have third-tier supplier and so on (Womack, Jones and Roos 2007:149-50). Although these parts are bought as commodities, the difference from exchanges that occur on the open market is that the relationship is not severed as soon as the component part has been delivered. Rather than being purely based on the exchange of commodities, the relationship among suppliers in Toyota’s system is put together by a “rational framework for determining costs, price and profits” that makes the suppliers work together for mutual benefit over the long-term rather than trying to maximize their profit at the expense of others in the short-term (Womack, Jones and Roos 2007:151).

⁹⁵ It is with reference to capitals that base capital accumulation on production of the means of subsistence (e.g. food and clothing) that the supply chain integrates only two circuits of capital. In that case, the circuit will have at least one supplier of means of production and will supply individual consumption. If the circuit in question produces means of production, it will be connected to at least two other circuits of capital; one as supplier and one as customer.

Both the supply chain and the circuit of capital are defined and described as a temporal process and a sequence of events or activities that encompass the entire cycle of production, distribution, and exchange. A few key form-analytic distinctions must be made. Whereas the circuit of capital describes the formal movement of a quantity of a given capital value, the supply chain describes the movement of matter through geographical and geophysical space-time. What the circuit describes is not events involved in a product's lifetime, but the supersensible movement of a given capital value. The production and distribution of products of labour in and through the supply chain, therefore, describe the movement of the sensuous-concrete; this material movement is the content of the circulation of capital. Whereas capital value has a circular path, stays in the individual circuit, and always returns to its starting point in money, the various materials this capital value is invested in go through a network of suppliers, distributors, transporters, and retailers; starting as raw material it goes through one or more steps of production and trade that finish when the end product is sold and destined for individual consumption.⁹⁶ The content or natural form of the sphere of production is the factory; while the content of the sphere of circulation is what Parker (1981:134) would refer to as capital's communication networks.

Based on these clarifications, I argue that the form-analytic relationship between the circuit of capital and the supply chain is that the circuit is the topological abstraction or the abstract space of the supply chain, with each sphere, stage, and form referring to spatial coordinates or temporal waypoints. The circuit of capital is, in essence, an abstract grid that establishes the points between which capital must move. Following arguments I have made elsewhere (Kjøsen 2013) and with Vincent Manzerolle (Manzerolle and Kjøsen 2014), the individual moments of the circuit of capital can be mapped onto locations in geographical space: M can refer to a corporation's headquarters from where the command to produce is issued and/or the location of the hoard of money (bank

⁹⁶ That the end consumer is an individual one is important when referring to supply chains. Productive consumers can never be end consumers considering that productive consumption yields yet another quantity of commodities that must be sold.

accounts and/or safes); P to points of production (factories); and C' to points of storage and/or exchange (warehouses, distribution centers and retail stores). The individual formal movements of purchase (M—L and M—Mp) and sale (C'—M') assume the existence and precise locations of open markets and various media (e.g. railways, ships, ports, and warehouses) to physically mediate these movements.

Figure 2 depicts the supply chain of Lululemon as a network of suppliers with the arrows showing the upstream to downstream flow of material.⁹⁷ As Figure 2 shows, the point of departure for the company's circuit of capital is its Vancouver headquarters; it sources and purchases means of production from factories in Europe, Peru, South Asia and South East Asia; produces their athleisure fashion in Canada and several Asian countries; and sells in the four national markets of Canada, US, Australia, and New Zealand

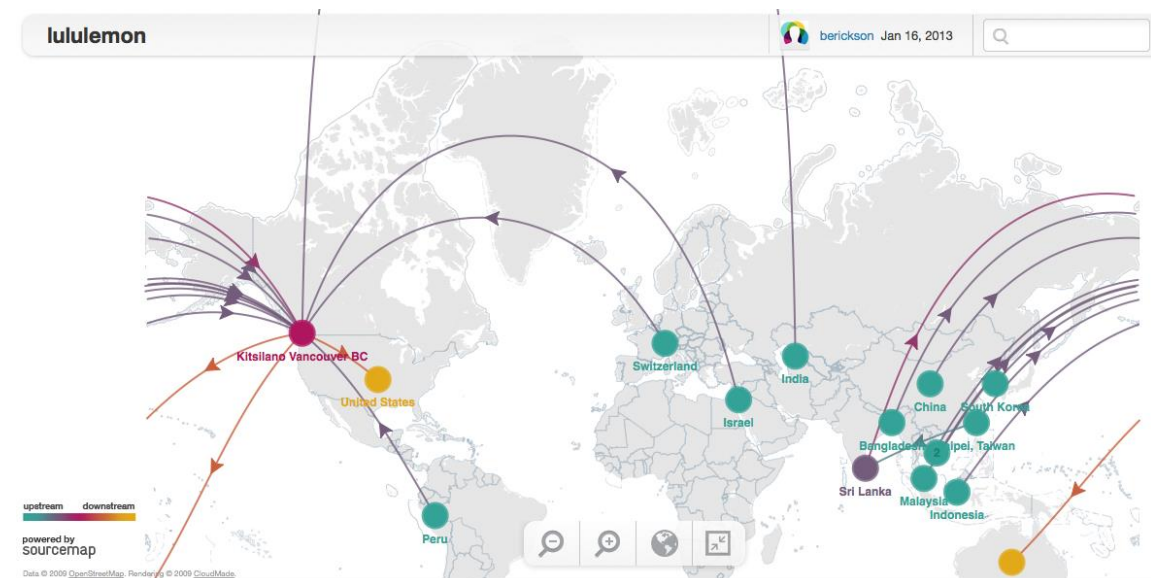


Figure 2: Lululemon's supply chain (Source: Sourcemap.com)

⁹⁷ While the arrows in figure 2 show only the flow of commodities, money goes in the opposite, upstream direction. In the figure, downstream flows are colour-coded as purple and yellow.

As my discussion of form-analysis in chapter one demonstrated, if something is determined by an economic form, it must be treated accordingly by the individually personified economic categories. I now turn to discussing the supply chain's determination as movement, circulation, or flow by anchoring the stretched factory thesis in Marx's analysis of the production process and the factory. This discussion is necessary because it reveals that the stretched factory of the supply chain is a production unit only in and through several circulation processes, which must be materially mediated in space and time by capital's media. The discussion, therefore, shows the position of capital's media within the social process of production.

2.3.1 The supply chain's social function

Marx argues that “valorized capital value [is] the purpose and result, *the function of the total process of the circuit of capital*” (1978:130, emphasis added). From the vantage point of production, the social function of the supply chain as the new form of the factory is to exploit labour in order to produce surplus-value. On this particular function and the struggles of labour employed along the global supply chain, I have nothing to add but instead defer to the analyses of Cowen (2014a; 2014b), Bonacich and Wilson (2008), and Toscano (2011; 2014). I argue, however, that the supply chain is additionally determined to keep matter flowing between its members because the different factories in the supply chain are connected by several circulation processes.

Cowen argues that the “architecture of global production and trade is built on the assumption of fast flows” (2014a:116) and that the supply chain is “network space of circulation ... dedicated to flows” (2014a:10). The flow of materials and the circulation of capital are necessary in order to reproduce the production process and accumulate capital. The reproduction process of capital is identical to its circulation process; for production to be renewed, newly produced commodities have to be sold, and the elements of production must be purchased as commodities. As I indicated in the previous section, the problem with Cowen's analysis is that she does not ground her argument in Marx's analysis of the production process, the factory, and associated phenomena like the division of labour and co-operation. Although her empirically grounded observation is

correct, she cannot explain why the stretched factory is dedicated to fast flows in terms of the logic of capital.

What does it mean that the factory has been geographically stretched in terms of Marx's value theory? Is it a continuation or a break with how Marx conceptualized the factory and the capitalist production process? What is the function of the means of transport and communications in the stretched factory? In the discussion that follows, I answer these questions, with particular attention to the spatial arrangement of production and the movement or flow of the object of labour between the different steps of production in the periods of manufacture and large-scale industry, and how they compare to the current period of supply chains and logistics.⁹⁸

2.3.1.1 Capitalist production

According to Marx, capitalist production starts when a large number of workers are employed and when the

labour process is carried out on an extensive scale, and yields relatively large quantities of products. *A large number of workers working together at the same time, in one place (or, if you like in the same field) under the command of the same capitalist* (1976:439, emphasis added).

Marx thus characterizes capitalist production in terms of the centrality of co-operation, which he considers to be fundamental to the capitalist mode of production (1976:454). Co-operation is a form of labour that occurs when “numerous workers work together side by side in accordance with a plan, whether in the same process, or in different but connected processes” (1976:443). How production is spatially arranged is important for co-operation as a form of labour to emerge. Marx argues that it is a “general rule” that workers must be in close proximity, i.e. work under the same roof: “workers cannot co-

⁹⁸ “Object” or “article of labour” simply refers to the object or article on which work is performed (Marx 1976:284).

operate without being brought together: their assembly in one place is a necessary condition for their co-operation” (1976:447).⁹⁹

But as soon as workers are placed side by side, the division of labour can begin or develop further. This division in turns changes the spatial arrangement of production and leads to the necessity of moving the object of labour according to this arrangement. According to Marx, the manufacturing period either introduced a division of labour into handicrafts-based labour process or further developed already existing ones. Whereas the individual handicraftsman would make the entire product, manufacturing splits production up into a series of specialized steps with the result that “the unfinished product passes from hand to hand” (Marx 1976:455). For Marx, the “perfected form” of manufacture is when

articles... go through connected phases of development, go step by step through a series of processes... as such a manufacture, when first started, combines scattered handicrafts, *it lessens the space by which the various phases of production are separated from each other. The time taken in passing from one stage to another is shortened*, and so is the labour by means of which these transitions are made (1976:463, emphasis added).

How Marx describes the perfected form of manufacture comes close to the vertically integrated factory that arguably saw its apotheosis in Henry Ford’s River Rouge Plant in Dearborn (Michigan). Although comparing manufacturing to Ford’s system of mass production is somewhat problematic considering that there is at least one intervening moment of capitalism—large-scale industry—between that of manufacture and Fordism, what is salient to this discussion is, however, the logic behind the spatial arrangement of capitalist production and to what degree Ford’s plant and the stretched factory represents a reversal or continuation of the spatial logic of the period of manufacture. What is interesting about the River Rouge Plant is the spatial arrangement of the production

⁹⁹ Marx recognizes that co-operation allows for production to be carried out over a large area. He is not, however, thinking in terms of separate, yet connected production units, but rather the large area as required by the object of labour, such as is needed for the construction of canals, railways, or the draining of marshes (1976:446).

process and the movement of the object of labour through the plant as it is worked up to its final natural form.

2.3.1.2 Flow in the River Rouge

In his desire for an entirely self-sufficient plant, Ford bought coal fields, forest, rubber plantations and anything that could supply the raw material that went into his Model T Ford. At River Rouge, he built a steel mill; rubber and tire, glass, and cement plants; press and motor-buildings, tool and die shops; and several less obvious production facilities.¹⁰⁰ By controlling raw materials and their processing in addition to the production process of his uniform black automobile, Ford created “the first integrated automobile factory” (Biggs 1996:151). What was innovative about the massive plant, which looked more like an industrial city than a factory, was not only that it produced almost every component of the Model T Ford, but the spatial organization of buildings and plants (Biggs 1996:137-8). In the fascinating *The Rational Factory*, Lindy Biggs (1996:118, 137-87) argues that design of the buildings that housed assembly line production—specifically Highland Park’s New Shop and the buildings at River Rouge—and the layout of the thousand acres on which the River Rouge Plant was constructed, were just as significant for Ford’s production method as the assembly line.

What Ford’s massive and spatially concentrated plant exemplifies is above all the principle that was peculiar to the period of manufacture—the division of labour. This division

requires the *isolation of various stages of production* and their interdependence of each other. The *establishment and maintenance of a connection* between the isolated functions require that *the article be transported incessantly from one hand to another, from one process to another*. From the standpoint of large-scale industry, this requirement

¹⁰⁰ These include a box factory, paper mill, waste heat power plant, benzol laboratory, and a soy bean extractor building.

emerges as a characteristic and costly limitation, and one that is inherent in the principle of manufacture (Marx 1976:463, emphasis added).¹⁰¹

At the same time, the River Rouge also exemplified the principle peculiar to the mode of large-scale industrial production, namely the production of machinery by machinery. Machinery is important because it furthers the division of labour and increases “the mass of raw materials, half-furnished products” so that the “working-up of these raw materials and half-finished products become split up into innumerable subdivisions. There is thus an increase in the number of the branches of social production” (Marx 1976:572).

A salient difference between the manufacturing Marx describes and that of River Rouge is that the unfinished product could not, and therefore did not, pass hand by hand. Although machines were placed closer than in most conventional shops, some parts were simply too large and/or heavy to be passed by hand and, importantly and as Figure 3 shows, the plant was not just one shop, but several different ones belonging to the same production process. Although a continuation of Marx’s logic, it is also a reversal in that space between the stages increased to such a length that mechanical means for passing objects of labour was necessary.

¹⁰¹ In a slightly different formulation, Marx argues that the division of labour can occur on the floor of an individual manufacturer and between various manufactures that “combined... form more or less separate departments of a complete manufacture, but... are at the same time independent processes, each with its own division of labour” (Marx 1976:467). Read “productive links or nodes” for “manufacture”, and “separate departments” and supply chain instead of “complete manufacture” and we already have the stretched factory that Cowen, Toscano and others theorize.

handling and the internal transportation network were arguably responses to the costly limitation of having the object of labour transported from one process to the next.

Although on a much more extensive scale than Marx could have imagined, the logic of Ford placing everything needed in the same location (if physically possible) is very similar to the one Marx identifies with manufacturing. A large number of workers were co-operating in one place, worked at the same time, and in the same field under the command of Ford and his management. Ford's factory would be perfection in the eyes of Marx as articles did go through "connected phases of development" in short time because the space between the various phases of production was in principle lessened. At the same time, the River Rouge also represents a reversal of Marx's logic because of the sheer number of different factories (not just a single one as in Marx's reasoning) and size of the plant. Hence the importance Ford's engineers placed on flow.

The degree to which the product of one process can be transferred to another process depends on the development of the means of communication and transport (Marx 1978:219). To move material and connect the myriad of individual factories, storage facilities and buildings, Ford's engineers had thirty miles of internal roads built and laid a vast network of railroads comprising over one hundred miles that included the High Line, a concrete structure forty feet high with a width that carried up to five railroad tracks and served as the Rouge's main artery (Biggs 1996:137, 157). According to Biggs, mechanical materials handling technology was the "final piece of Fordism" (1996:121). While the space between the different stages of production was more extensive than Marx's perfect form of manufacture, Ford's particular means of transportation annihilated this space by time.

Although these means of communication were particular to the conditions of production at Ford's plant (rather than belonging to the general conditions of production), what the example of the River Rouge points to is the increasing necessity of such means when the social division of labour deepens and is increasingly geographically dispersed. With the fragmentation and stretching of the vertically integrated factory into supply chains extended across the globe, the division of labour is also geographical and is mediated by

many circulation processes—a key difference between the internal flows of Ford’s factory and the global flows of the stretched factory. What passes between the different stages of production is no longer merely an object or article of labour, but a commodity that must be sold and bought before it can be worked up further.

According to Marx, an isolated phase of production is nothing more than a “particular stage in the development of a finished article”, meaning that workers in each stage prepares raw material or the object of labour for a group of workers in another stage so that the “result of labour of the one is the starting point for the labour of the other” (Marx 1976:464). The logic of the supply chain should be clear; it is not the worker any longer that is the starting point for the labour of another, but a labour process belonging to another circuit of capital. In an apparent nod to Adam Smith’s invisible hand, Marx refers to “an *invisible bond* uniting the various branches of trade. For instance, the cattle-breeder produces hides, the tanner makes hides into leather, and the shoemaker makes the leather into boots. Here *the product of each man is merely a step towards the final form*, which is the combined product of their specialized labours” (Marx 1976:474-5, emphasis added).¹⁰³ He then asks what this bond is and replies that it “is the fact that their respective products are commodities” (Marx 1976:475). With “final form,” Marx is here referring to natural form and with “invisible bond” to value. Together the two refer to the immanent contradiction of the commodity.

That the commodity is the invisible bond means that the connection between different circuits of capital is the commodity’s formal movement (C’—M’); although because a sale is simultaneously a purchase and a formal movement of money (M—C), the invisible bond is more precisely circulation. As Marx argues, the social division of labour is “mediated through the purchase and sale of the products of different branches of industry” (Marx 1976:475-6). In other words, circulation connects individual and

¹⁰³ In the stretched factory, not all of these steps occur in factories but at “decoupling points”, i.e. delaying final assembly as close to the market as possible. A good example of the necessity of delayed assembly is in found in consumer electronics that may require different power modules depending on where in the world they are sold (Rushton, Croucher and Baker 2014:187).

independent circuits of capital and integrates them into a supply chain. That Marx qualifies the bond as invisible is a clue that he is referring to the supersensible movement of value as what connects different branches of industry. The stretched factory is a unit only by and through the (aligned) circulation of commodity capital, which is the sensible-supersensible process that links different points of production with commodities in various steps towards their final forms. Even intermediate products appear in the social form of the commodity and must perform exchanges, although it does not necessarily go to a market but rather to a different point of production in this particular case.

In a spatial organization of production in which the commodity takes steps that may be countries or even continents apart, the necessity of the means of communication and their development in terms of speed and capacity become even more pronounced, but now as the general conditions of production and therefore functioning as media for (potentially) all individual capitals. The position of capital's media in the social process of production is therefore between different points of production, or between a point of production and a point of exchange, i.e. the market.

2.3.1.3 Flow in the stretched factory

When Marx mentioned the spatial isolation of the phases of production and the necessity of transporting the object of labour between these isolated locations, he was at first concerned with the manufacturing floor. The argument about the “extensive scale” of manufacture and the necessity of workers being under the same roof can, however, be used to explain production tied together in supply chains. The stretched factory implies a labour process on an extensive scale by orders of magnitude and in terms of geography rather than the enlarged floor of the workshop that Marx had in mind.¹⁰⁴ In *Capital Vol. 2*, however, Marx recognizes that the isolation of productive phases can also be geographical.

¹⁰⁴ While there is little difference between the period of manufacturing from handicraft production, the former represents “an enlargement of the workshop of the master craftsman of the guilds” (Marx 1976:439). Enlargement here means both in terms of workers employed and the space of the site of production considering the more people are employed, the more space is required.

Within every production process, the change of location of the object of labour and the means of labour and labour-power needed for this plays a major role; for instance, cotton that is moved from the carding shop into the spinning shed, coal lifted from the pit to the surface. *The transfer of the finished product as a finished commodity from one separate place of production to another a certain distance away shows the phenomenon only on a larger scale.* The transport of products from one place of production to that of another is followed by that of the finished products from the sphere of production to the sphere of consumption (1978:227, emphasis added).

What is remarkable about this quote is that Marx is, in essence, describing a supply chain involving at least two different production processes, a transportation process, and the market. More importantly is that he is identifying the increasing importance of movement between different production facilities because this movement indicates that (1) the function of the supply chain is to move matter between points of production and eventually to the market, and (2) that moving these things is dependent on adequate means of communication.

To illustrate this argument, I refer to Figure 4, which shows the location of smartphone production activities in the Asia-Pacific Economic Cooperation (APEC) region according to each country's degree of involvement in research and development, final assembly, and production of low, medium and high-value parts.¹⁰⁵ In other words, Figure 4 shows potential points of production for a stretched factory making smart phones and thus a spatially dispersed rather than a concentrated factory. A hypothetical new designer of smartphones located in the US would find its upstream suppliers in any of these countries. Assuming that research and development occurs in the home country of this hypothetical company, high value components could be secured from a number of countries, but most likely from Korea, Japan, US, Taiwan and Singapore; medium value components from China, Taiwan, US, Japan and Taiwan; and low value components from China, Japan, Korea, Taiwan and Malaysia. All of these suppliers will have their

¹⁰⁵ High-value parts (>\$20) include flash memory, display and app processor; medium value parts (\$5-\$20) include integrated circuit, camera module, and battery; low value parts (<\$10) include image sensors, power management and microphone (Wood and Tetlow 2013:24).

own suppliers, who are not depicted in the figure. Final assembly of the smartphone would most likely occur in China or Mexico, which requires the delivery of the different parts to the particular points of production in these countries from wherever they were sourced and produced just-in-time. In other words, the factory of our hypothetical smartphone company would be stretched according to the geography of and particular division of labour in the electronics industry in the APEC region. That the different productive activities occur in several different countries—and within countries in several factories—means that the supply chain is agile. The hypothetical company would be able to change suppliers from one to another relatively easy if, say, a particular component can be found cheaper elsewhere, or a sudden natural disaster makes it difficult or impossible to obtain components from the current supplier (Wood and Tetlow 2013:24-7).

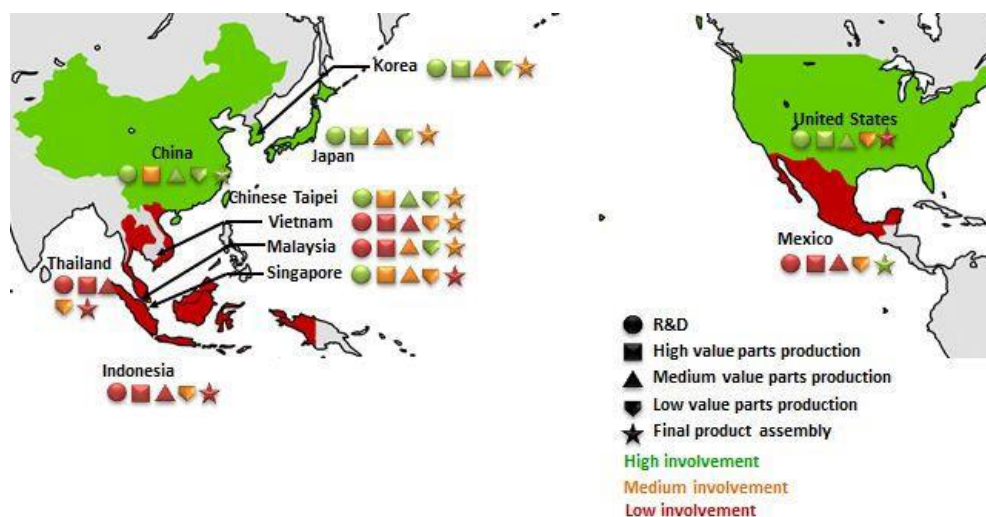


Figure 4: Location of smartphone production activities in the APEC region (Source: Wood and Tetlow 2013:25)

The River Rouge Plant is an example of both the extension and reversal of the logic of the labour process of the manufacturing period: it is carried out on an extensive scale with large numbers of workers co-operating in the same space, while the object of labour takes less time in going through the connected yet isolated phases of production because the space between them are shortened. The reversal of the spatial logic of this argument is

complete with the advent of global supply chains.¹⁰⁶ The key differences between the example of River Rouge and what Marx defined as the beginning of capitalist production, however, are that if we treat the supply chain as the unit of production rather than its individual and constituent productive parts, workers may not be working together neither at the same time nor in one place even if in the same field, and not under the same capitalist. Rather they work together in different places and sequence or according to a schedule and/or the *Kanban* (signal) of a just-in-time production system. Also, the very existence of supply chains is evidence that workers' co-presence in one place is no longer a necessary condition for co-operation. Marx's general rule therefore no longer holds, and his definition of co-operation must be altered to "numerous workers work together in accordance with a plan in different but connected processes" to account for the production network that is the stretched factory. Workers can work together even at spatially removed sites if they are somehow connected and temporally aligned, thus making different production processes into one unit even if they are continents apart.

In chapter one, I argued for why material movement is a determination of the commodity and how it is tied to the being of value. As with the commodity, so with capital. That the supply chain is determined to move as much as it is determined to make, is tied to the ontology of capital:

Capital as self-valorizing value, does not just comprise class relations, a definite social character that depends on the existence of labour as wage-labour. It is a movement, a circulatory process through different stages, which itself in turn includes three different forms of the circulatory process. *Hence it can only be grasped as a movement and not as a static thing. Those who consider the autonomization of value as a mere abstraction forget that the movement of industrial capital is this abstraction in action* (Marx 1978:185, emphasis added).

That Marx stresses capital's ontological being-as-movement, and that it can be conceived neither as a thing nor a pure abstraction means that the supersensible is dependent on the

¹⁰⁶ At individual points or nodes of production, however, the organization of the factory floor may very well be a continuation of the spatial logic and the deepening of the division of labour that Marx identified.

sensible material in which it is invested. Adorno makes precisely this argument: the material is “dragged along” and must “persist” so that “independent value does not collapse incoherently into itself” (in Reichelt 2007:42).

Given that the supersensible movement of capital consists of a change of forms, it can maintain itself only by constantly dragging sensuous objects into and expelling them from the circular path of capital (Reichelt 2005:62). The sensuous object is “demoted to something that constantly vanishes” (Reichelt 2005:46). Reichelt explains the relationship between the formal movement of capital and its concrete movement as follows:

Capital is... conceived as a constant change of forms, into which use-value is constantly both integrated and expelled. In this process, use-value too, assumes the form of an eternally vanishing object. But this constantly renewed disappearance of the object is the condition for the perpetuation of value itself... What is thus constituted is an inverted world, in which sensuousness in the widest sense... is demoted to a means of the self-perpetuation of an abstract process that underlies the whole objective world of constant change (2005:46-7).

This integration and expulsion of matter from the circuit of capital helps to explain how the supply chain is determined by capital. The social function of the supply chain is to facilitate the continuous appearance and disappearance of things, people, and information for the perpetuation of capital as an abstract process. More specifically, the elements of production, as soon as they have been purchased and after an inbound logistics process, are integrated into the first stage of the circuit; as soon as they have really metamorphosed into new commodities, they are first expelled from the production stage and then the third stage of the circuit as soon as they have gone to market and performed exchanges.¹⁰⁷ The material of money—coin, paper or differences in voltage—is removed in the first stage and inserted in the third stage. Marx speaks of this necessity in *Capital*

¹⁰⁷ The incoming logistics process of supply and materials management refers to the storage and flow of use-values into and through the production process, while the outgoing logistics process of distribution refers to the storage and flow of use-values from the final point of production to the end customer (Rushton, Croucher and Baker 2014:4).

Vol 2, arguing that at the market, a given use-value, such as yarn, is merely a commodity, but “as a moment of the circulation of capital it functions as *commodity capital*, a form that the capital value alternately assumes and discards. When the yarn is sold... it is removed from the circuit of that capital whose product it is” (1978:149). The yarn goes into individual or productive consumption, or passes through an additional circulation process in the hands of a merchant, while the capital value that was just objectified in the yarn continues in the circuit in the form of money.

2.4 Conclusion

International trade is no longer dominated by essential raw materials or finished commodities because commodities today go through many more steps toward their final form than before. What is moved—in shipping containers—between points of production are intermediate goods, parts of parts, or factory inputs that have been partially worked up and will take several steps around the globe before becoming a final commodity. Indeed, less than a third of containers that moved through southern California in 1998 contained finished commodities but instead held the “invisible bonds” of the supply chain (Levinson 2006:268; Klose 2015:102-3). This increase in intermediate products is the reason the means of communication and transport have become more important to the mode of production in its logistical period. The relationship between the supply chain and the physical conditions of exchange, i.e. capital’s media, can now be identified. Whereas the supply chain is the material grid in which the various points of production and exchange are located, capital’s media—be it the static media of infrastructure or dynamic, moving vehicles—connects these points and thus different circuits of capital to one another. Moreover, through this connection, capital’s media contribute to the reproduction of capital.

The physical conditions of exchange become more and more important the more steps a product must take towards its final form and the more production processes are isolated from each other. Without cheap, fast, and efficient means of communication, the factory cannot be stretched across the globe. Although the commodity is the “invisible bond” that connects circuits of capital, it cannot perform this function if it is inert. While the guardian was a sufficient vehicle and medium for the mobilization of commodities

produced according to the theoretical fiction of so-called “simple production” of Chapter One, the media system capable of mobilizing commodity-capital at the speed and in the quantity required by the stretched factory is “organized around the standard shipping container and the intermodal infrastructures that supports its mobility across rail, road and especially sea” (Cowen 2014b). To Cowen’s list, I add distribution centers and warehouses, and point-of-sale and payment systems. I turn to these particular media systems in the following three chapters.

Part 2: The Physical Conditions of Circulation

Introduction: The 21st Century's Crowning Work

In a letter to Nikolai Frantzevich Danielson,¹⁰⁸ Marx (1879) writes that the

railways sprang up first as the *couronnement de l'oeuvre* [crowning work] in those countries where *modern industry was most developed*, England, United States, Belgium, France, etc. I call them the "*couronnement de l'oeuvre*"... in the sense that they were at last (together with steamships for oceanic intercourse and the telegraphs) the *means of communication* adequate to the modern means of production...

To Danielson, Marx is restating an argument he had already made in *Capital Vol. 1* and that I quoted at length in chapter two while discussing the general conditions of production. The “crowning work” together with steamships and the telegraph form a media system that no longer held production back as its fetter, but gave large-scale industrial production the elasticity it required. In Marx’s political economy, the *couronnement de l'oeuvre* should be understood as the media that at any given point have been adapted and are adequate to a particular historical expression of the capitalist mode of production. But what are the adequate media of the mode of production in its logistical period? What means of communication would Marx consider as the *couronnement de l'oeuvre* if he had lived today and developed his political economy around the turn to the 21st century?

Having analyzed why value—and by extension capital—must move as material objects perpetuate its abstract existence in chapter one, and the path capital takes as it moves between the various points of production and exchange in the supply chain in chapter two, in the following three chapters I turn to how capital moves but in the sense of “with what means” it moves. While capital is an abstraction, it is also a material thing that cannot move on its own; it must be mobilized for the purpose of circulation, which is done with its media. If the commodity and its circulation is the invisible bond that ties

¹⁰⁸ Danielson was the Russian translator of *Das Kapital*.

different production processes together, then the examples of capital's media I discuss in this part are the visible or sensible bond. Hence, in this second part, I analyze how the formal movement of capital is materially mediated by presenting the specific operations of three of capital's current adequate media systems.¹⁰⁹

When production is stretched out geographically and organized into sprawling supply chains, efficient logistics in the planning of production and transporting freight is essential. The co-ordination of capital's movement depends on media such as computers and telecommunications, but also on fast, efficient, and cheap transportation. A key innovation accompanying or even making the logistics revolution possible was the standard shipping container. In chapter three, I discuss the container and how it revolutionized international shipping by solving the gridlock on the docks and integrating the separate modes of transportation of ship, train, and truck into an intermodal system of transportation. The intermodal transportation system serves as the primary case study of capital's media because it is arguably the 21st century's crowning work for transporting capital in commodity form.

While the container and intermodal transportation serve as the primary case study, I discuss two additional media system that I consider to be adequate to logistical capitalism.¹¹⁰ In chapter four, I discuss the stationary, but networked media system of distribution centers that operate to mediate the movement of capital by routing it to the

¹⁰⁹ I use the term operation to distinguish it from function; the relationship between the two can be understood as function being the form of a material operation. It is in their respective material operations that certain things come to function within and for the circulation process. For example, the operation of a containership steaming across the Pacific takes the form of the function of transfer; or when a distribution center operates to route commodities on to their next location, the operation is expressed as the function of processing. I discuss capital's media functions in chapter six.

¹¹⁰ The reason why the container and intermodal transportation serve as the main case study is partly due to the available literature (see e.g. Cudhay 2006; Levinson 2006; Reifer 2007; George 2013 Klose 2015; Glück 2015; D'eraimo 2015). Although distribution centers are vital for the movement of capital, as of now there exists no equivalent book length treatment on this new incarnation of the warehouse that can compare to Marc Levinson's (2006) seminal *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger* or Alexander Klose's (2015) *The Container Principle: How a Box Changes the Way We Think*.

next point in the supply chain or holding it back in storage in wait for the right time to send it on to the next destination. That the distribution center is an adequate medium is evidenced by a boom in their construction in North America, because they are building blocks of just-in-time retailing and are viewed as a source of competitive advantage in retailing by behemoths like Walmart, Target, and Amazon (Abernathy et. al. 1999:63-6; Lichtenstein 2009:38-9; Egan 2014; Rusthon et. al. 2014:255-8; Wulfraat 2014; 2105; 2016a; 2016b).

In chapter five, I discuss point-of-sale (POS) systems as the final case study of capital's media. These media are different from the two other cases due to their location at the point of exchange. The POS-system refers to a media system that consists of technologies found at the checkout counter, including the cash register, the barcode and associated hardware, and payment terminals. In the chapter, I hone in on two specific operations of this media system: (1) collecting data about the moment of exchange; and (2) collection and processing of payments. The collection of so-called POS-data through scanning barcodes is vital for the material mediation of the formal movement of capital. POS-data is used as corrective feedback for adjusting replenishment orders and/or batches of production, and for knowing when commodities should be shipped where. The barcode's significance cannot be underestimated; it allowed for the effective integration of the retailing front-end for selling with the back-end of finance and inventory management. John T. Dunlop and Jan W. Rivkin argue that the barcode was as revolutionary in its impact as the railroad and the telegraph (1997:17).

Via the payment terminal for swiping payment cards, POS-systems are connected to payment systems like VISA, Mastercard, and Interac. Including payment systems in this dissertation is important because they materially mediate the movement of money capital as opposed to commodity capital. Specifically, payment systems operate to turn commodities into money and subsequently to repatriate money back to the capitalist and thus to the point of departure in the circuit of capital. Together with payment cards (credit or debit), they accelerate exchanges by making equivalents accessible for exchange and, in the case of credit, stimulating more purchases than when cash alone is used (Evans and Schmalensee 2005; Stearns 2011).

There are a few reasons why these particular case studies were chosen as examples of capital's media. First, I continue the narrativization of the commodity's journey to the market. In chapter one, I narrated the commodity's movement from its point of production to the market and metamorphosis into money in terms of the commodity's social function. In chapter two, I specified that the commodity does not go directly to the market, but takes several steps towards its final (natural) form by moving from one point of production to the next before it is finished. In the three chapters that constitute this part of the dissertation, I continue this narrative by focusing on how the commodity goes to market after it has entered North America in containers. The chapter on the standard container and intermodal transportation traces the movement of containerized commodity capital from the container ship's unloading process, change of mode of transportation to truck or rail, and its movement on highways and railways towards the distribution center as its next destination. The succeeding chapter on distribution centers follows the commodity after it has been unpacked from containers, its routing through the facility, and its movement in trucks headed for retail stores. Lastly, the chapter on POS-systems follows capital's transformation into money and subsequent repatriation to the capitalist. Together these three media systems form a total media system that provides logistical support for capital in the sphere of circulation.

Second, the different media systems and individual components I discuss are things that function as capital's media of transfer, storage, or processing. In addition, I also discuss things that function as media for commodity capital or for money capital. In other words, examining the operations of ports, intermodal transportation, distribution centers, and POS-systems, enables me in the sixth and final chapter to discuss why capital's media is a category that is filled with material content, thereby completing my Marxist media ontology.

Third, the media systems discussed in the following three chapters were chosen because they are adequate to logistical capitalism. These media systems are a remediation of the previously inadequate media and therefore demonstrate how capital's media change and develop. Whereas the railways, steamships, and telegraph of large-scale industrial production can be understood as a logical remediation of the human vehicle-as-guardian,

the media systems of intermodal transportation, distribution centers, and POS-systems are logically a remediation of large-scale industry's media systems become more adequate to logistical capitalism. I write 'logically' because the examples of capital's media I discuss in this part historically replaced the media system of the Fordist period. Indeed, most of these technologies were invented or reached maturity during the 1970s or early 1980s, which Marxists scholars have identified as the decades in which the capitalist mode of production exited its Fordist period (see e.g. Harvey 1990; Dyer-Witheford 1999).

Before I turn to these media systems in their respective chapters, it is, however, necessary to make a few theoretical and methodological clarifications concerning logistical capitalism, the characteristics of media, and the relationship between machinery and media.

Logistics, flexibility, and push and pull

When Marx discussed the development of the means of communication and transport in the context of the general conditions of production, he argued that the mode of production of large-scale industry required the media system of "river steamers, railways, ocean steamers and telegraphs" to deal with the "feverish velocity" and "enormous extent" of its production and "connections with the world market" (1976:506). If this argument is generalized, Marx is stating that the new media system must be an improvement in terms of speed and carrying capacity which is capable of moving, storing, and distributing the output of the new level of production, giving the mode of production elasticity. It is thus on the basis of increased speed and/or capacity that a media system can be justified as being either adequate or inadequate to a new mode of production. As a medium of transfer, the container box cannot merely move things, but must move things faster and/or in larger quantities as an advance on the media system it replaced.

To better explain how capital's media change based on its inadequacy to the mode of production, it is necessary to discuss something that I left out of the previous chapter's comments on logistical capitalism. Whereas I have focused on the spatial arrangement of production to explain how the paths of capital's movement are determined, I now

consider this type of production's output in terms of its speed, volume, and variety, and what elasticity means in this period of the capitalist mode of production.

The Fordist period was characterized by mass production of homogenous commodities, involving long production runs to gain efficiencies of scale and minimize unit cost, and an effort to keep factories running at full productive capacity (Harvey 1990:155-6, 177; Bonacich and Hardie 2006:169; Bonacich and Wilson 2006:230). Production was authorized based on forecasting in advance of customer orders, but because forecasting was far from accurate, the effect of long production runs of large batches of commodities was large inventory surpluses. In effect, commodities were made-to-stock, and demand was met through existing inventory (Li 2007:16). Manufacturers got rid of their surpluses by effectively "pushing" their commodities downstream onto retailers who bought what was supplied and assumed the risk of whether this supply matched up with demand (Klose 2015:157).

A purely push approach is today considered wasteful in terms of time, cost, and shelf space. A basic purpose of the logistics revolution—the shift from push to pull—was to improve the accuracy of forecasting in order "to improve sales by getting a clearer command of what is actually selling" in order to avoid the "twin dangers of producing too much of products that are not selling or too little of products in heavy demand" (Bonacich and Wilson 2006:230). In the pull approach, demand is tracked by the retailer collecting information at point-of-sale (POS) and transmitting it to upstream suppliers. Ideally, commodities are produced to order by actual demand, triggering the decision to produce and/or replenish a particular commodity. The commodity is therefore effectively "pulled" through the supply chain in response to an actual purchase in order to be at the right place and time, and in the right quantity. While push system production runs were large and infrequent, the pull system's short production runs of small batches are reflected in the increased frequency of shipments, which are usually ongoing weekly or bi-weekly orders of what sells (Abernathy et. al. 1999:56; Bonacich and Hardie 2006:172).

In the logistical period of the capitalist mode of production, the specific way in which this mode gains a capacity for sudden extension in leaps and bounds is through “flexibility.”¹¹¹ Flexibility should, therefore, be understood first and foremost as the ability to respond to shifting demand, which requires the production and distribution of customizable and much greater variety of commodities (Bonacich and Wilson 2008:12). Flexible production is therefore tied to product proliferation and increased customization; in the stretched factory this flexible production is reflected in the increasing number of steps a commodity has to take before it is in its final (natural) form. The final natural form of the commodity is thus a “combination of modular components, sets of basic types with minimal variation, from which the buyer must choose” (Klose 2015:160). A second understanding of flexibility refers to flexible production schedules or contingent production. Rather than long and predictable production runs, commodities are increasingly produced on an as-needed basis. Flexible production is oriented towards demand and can be understood more broadly as representing the shift from “push” to “pull” production and distribution.¹¹²

The characteristics of media

Innis argued that understanding a given civilization from a communications perspective required a consideration of the material characteristics and inherent properties of the

¹¹¹ Flexibility here in the sense of flexible production or flexible accumulation that is associated with so-called post-Fordism (see Harvey 1990).

¹¹² These two types of flexibility were made possible by a third type of flexibility, which is related to the virtual integration of companies into supply chains. Although the ideal is to form stable, long-term partnerships between producers, distributors, wholesalers and retailers, a supply chain can change its composition at any time given that it is a virtual integration between independent and individual circuits of capital rather than a vertical or horizontal integration based on the ownership of all links in the chain. It is non-ownership, particularly of production facilities, that gives behemoth retailers like Wal-Mart or design companies like Dell and Apple tremendous flexibility or agility in switching between suppliers and distributors for almost any reason; suppliers can be dropped almost at any notice and are therefore used on an as-needed basis. Given that production facilities are the least mobile of all capital (Harvey 2006:376), the non-ownership of such productive capital means that the capital of those companies that trade in the production of others is extremely mobile and they can use this capital to alter the socio-geographical allocation of labour by shifting the location of production from factory to factory irrespective of country (Bonacich and Wilson 2008:27).

civilization's dominant media, whether it be the spoken word in oral societies, writing on stone, clay or papyrus in ancient civilizations, or the electronic media of modern Western civilization (Innis 2006; 2008:33; Heyer and Crowley 2008:xxxii). He was concerned with how the material characteristics of a medium made it biased towards either space or time. While somewhat of a simplification, Innis considered media that were heavy and durable to be biased towards time and that light and fragile media were biased towards space due to their portability. The characteristics that make a medium suitable for sending a message across time (durability) makes it unsuitable for being sent across space (portability) and vice versa. In turn, this consideration was accompanied by an assessment of how the medium was used. For example, if the medium was used for writing, such as papyrus, Innis discussed the type of script and writing implements used, and the political economy of the institution that incorporated it because such characteristics influenced the relative bias of the medium and thus of the society in which it existed (Heyer and Crowley 2008: xxxii-xxxiii).

A focus on inherent properties and material characteristics of media mean that this dissertation's analysis now shifts from a focus on social form to the natural or material form of things, i.e. their use-values.¹¹³ It is impossible to account for how capital's formal movement is materially mediated without this shift in the analysis. This new materialist approach is, however, a dangerous path to take for the heterodox Marxist. The orthodox Marxist may accuse such an approach of being fetishistic; if the following three chapters were my final words on what capital's media are, such an accusation would be correct. Presenting the material characteristics and operations of capital's media is, however, necessary in order to delineate media as a form which expresses the definite functions of transfer, storage, and processing in the final and concluding chapter. As I argue in chapter six, media is not something that things *are*, but a category in which they *appear* when they function within and for the circulation process.

¹¹³ The way in which Marx defines use-value arguably comes close to what Innis refers to as material characteristics. In discussing use-value, Marx argues that it is "conditioned by the physical properties of the commodity" and therefore refers to "the physical body of the commodity itself" (1976:126). Characteristics such as size, weight, durability, and fragility therefore refers to use-value.

Approaching the means of communication through a focus on their material characteristics is, however, not completely foreign to Marxism. In fact, Marx did pay attention to the properties of, for example, the railways in a similar way to how Innis studied the characteristics of media. Marx ([1862] 1984) collected and published statistical material on the United Kingdom's length of railways, numbers of tunnels, bridges, locomotives and railcars, and the required labour power to build, maintain, and run them. On locomotives, he wrote about how the steam engine made them capable of pulling "30 passenger cars, each weighing 5 ½ tons, at 30 miles an hour, or 500 tons of goods at 20 miles per hour", even making references to specific locomotives, like the *Liverpool*, which at full load poured out 1,140 horsepower, and consumed a ton of coal and up 1,500 gallons of water daily (Marx 1984:150).¹¹⁴ Naturally, Marx also considered the political economy of the railways, arguing that they were a "parvenu form of wealth, the most colossal offspring of modern industry, a remarkable economic hybrid whose feet are rooted in the earth and whose head lives on the stock exchange" (1984:149).

When Innis paid attention to the characteristics of a particular medium, he was not only interested in a clearly delineated and singular object. While paper is a medium for writing, the paper in and of itself does not make such a medium: it requires writing implements, a script, literacy, raw material like Canadian timber, which must first be transported in ships and then processed into paper in the metropolitan center before it can be used as an inscription surface for handwritten letters or the mechanical type of the printing press (Innis 2008). Similarly, Marx writes not just about the railways as a set of tracks made of steel rails, but also tunnels, bridges, locomotives, passenger cars, freight cars, the steam engine, workers, coal, water, joint stock companies and the stock exchange.

¹¹⁴ Due to copyright holder Lawrence & Wishart forcing the Marxist Internet Archive to delete all texts that originated from the *Marx and Engels Collected Works* (MECW), I have not been able to figure out whether Marx (or Engels) wrote about other means of communication, such as the telegraph and steam ships, in a similar way.

Moreover, although Marx favoured the railways when speaking of the means of communication, he typically refers to it next to other examples of the means of communication. In *Capital Vol. 1*, he refers to the “*system of river steamers, railways, ocean steamers and telegraphs*” (1976:506, emphasis added). In other words, capital’s media are always already systems that consist of so many different components. Marx’s “dissection” of the railways served as an example as to what components that particular media system included. Following Marx, it makes little sense to analyze a component in isolation from the media system or network of which it is a part. For example, it would be pointless to discuss the standard shipping container without reference to ships, ports, cranes, trucks, and trains because containers cannot themselves go to ports and perform modal changes in their own right, and trucks and trains cannot move containers without the infrastructure of highways and railways. Without docks, conveyors, scanners, and barcodes a distribution center cannot route commodities; and for this routing to even be possible in the first place, the distribution center is dependent on trucks delivering packaged and/or palletized commodities. Similarly, it makes little sense to discuss POS-systems without reference to the barcode and laser scanners, and payment cards are worthless without payment terminals and automated clearing houses. Moreover, these media systems cannot be considered as separate from one another given that one media system passes commodities on to the next one; their collective content is the forms of capital in circulation.

Machinery and media: production time and circulation time

In the previous chapter, I argued that because of the liminal status of the means of communication and transport as functioning within and for both the production and circulation processes, capital’s media can be understood as a counterpart to machinery in circulation. I reiterate this argument here because most things I discuss in the following three chapters as media would typically be referred to as machinery by many Marxists. And from the point of view of production, things like ships and trains or a distribution center’s conveyors or automated storage and retrieval (ASAR) system *are* machinery that function to increase the productivity of labour and produce (relative) surplus-value by

altering the ratio between necessary and surplus labour relatively. As Marx argues, “the machine is a means for producing surplus-value” (1976:492).¹¹⁵

As I argued in the previous chapter, from the point of view of circulation, machinery employed in the communication and transportation branches of production can be analyzed as functioning within and for the circulation process and therefore as capital’s media. How can machinery’s functioning be understood as the functioning of capital’s media? I argue that by switching vantage point, the effect machinery has on labour-time and production time is transposed to circulation time. Before I explain how this occurs, it is first necessary to clarify the difference between production and circulation time.

The movement of capital through the sphere of production and the two stages in the sphere of circulation occurs successively in time. The duration of capital’s movement through the sphere of production comprise its production time, while the time it takes to move through the sphere of circulation is capital’s circulation time. The total time capital takes to complete a circuit is its turnover time (Marx 1978:200). Production time includes the duration of the labour process or working time; the former, however, can be longer than the latter due to interruptions in working time which happens when the object of labour is exposed to physical, chemical, or natural processes. For example, after fields have been sown or when wine is left to ferment, no additional labour is needed, but the wheat or wine is nevertheless being produced.¹¹⁶

¹¹⁵ Even the automated checkout counter (POS-system) that is used in the sphere of circulation would be a machine even though any labour (such as the labour of the checkout worker) that merely posits value in its form is not productive of surplus-value despite surplus labour being performed (Marx 1978:207-11). The wages of labour employed in the sphere of circulation is a cost of circulation and a deduction from surplus-value (Marx 1978:209-10). The wages of unproductive labour employed in the sphere of circulation do, however, comprise necessary labour, which the worker must reproduce. By increasing the productivity of this worker all that happens is that she reproduces her wage in less time than before with the effect of extending the time that she works for free for the capitalist (Marx 1978:210).

¹¹⁶ Although no additional labour may be required, machinery and other forms of fixed capital (such as the barrel in which wine ferments) still function to transfer part of its value to the final product and may help speed up chemical or physical processes (Marx 1978:210).

As discussed in chapter two, Marx divides the sphere of circulation into the stages of sale (C'—M') and purchase (M—C). Consequently, circulation time can be broken down into two parts; whereas selling time reflects the time needed to convert commodity capital into money, purchasing-time represents the time needed to convert money capital into the commodities labour-power and means of production (Marx 1978:204).¹¹⁷ Importantly, Marx argues that a permanent cause of differences in circulation time between independent circuits of capital is the distance between the points of the commodity's production and exchange (Marx 1978:327). The time of transportation is therefore included in selling and purchasing time.¹¹⁸ Marx also includes the repatriation of money in purchasing time.¹¹⁹

To understand how production time is translated into circulation time, it is necessary to recall that circuits of capital can be integrated via their circulation processes into a supply chain. An implication of such integration is that the respective production and circulation times of different capitals reciprocally condition one another. In *Grundrisse*, Marx makes an argument about this mutual conditioning, writing that the “duration of one capital's production phase determines the velocity of the other's circulation phase. Their *simultaneity* is a condition required so that [circulation] is not obstructed” (1973:520). While Marx made this argument in the context of a capitalist waiting for a particular

¹¹⁷ Selling time is therefore the interval in which capital assumes the particular form of the commodity; buying time is therefore the interval in which capital is stuck in the money form.

¹¹⁸ That transportation time is included in purchasing time can be explained in terms of when the buyer takes possession of the commodity. For example, the buyer could take possession of the commodities at the factory gate which means that the entire time it takes to transport the commodities to where the buyer wants them is included in purchasing time.

¹¹⁹ Using the example of a (presumably English) capitalist sending his commodities on a four months journey to India, Marx argues that even if both selling time and purchasing time is zero, it would take another four months to repatriate the natural form of money (be it metallic coin or paper) with the net result that it would take a total of eight months before that valorized capital value could function again as productive capital (Marx 1978:329). Of course, Marx made this argument long prior to the advent of the emergence of electronic money proper and media systems for transferring money capital like VISA and Mastercard (see Evans and Schmalensee 2005; Stearns 2011). Rather than taking four months to repatriate, the money could be transferred in mere seconds, albeit, the clearing and settlement process of payments means that repatriation may in fact take a few days.

commodity to produced, if the production phase Marx refers to is that of transportation, the production time of the transporter can be directly translated into a component of the circulation time of the commodity capital that is transported.¹²⁰

Although the circuits of transport capital reduce their production times through introducing technology that is productive in terms of speed, power, and capacity, this productivity translates into reduced circulation times for the circuits of capital whose commodity capital is sensibly moved. The same translation occurs when I refer to media that cannot necessarily be directly identified with a specific machine, such as the maritime container port or the distribution center (their productive counterparts are more appropriately the factory). From the point of view of circulation, productivity increases in the branch of communication and transport may translate into reduced circulation times for other circuits of capital, especially if the latter depends on the former to materially mediate their circulating capital. As I discuss in chapter six, a general function of capital's media is to reduce circulation time, i.e. to accelerate capital's movement through the sphere of circulation.

Before I turn to the standard container and intermodal transportation, I make a final comment about capital's media in relation to selling and buying time. Marx argues that under normal circumstances, the sale "is the most difficult part of [capital's] metamorphosis, and thus forms the greater part of the circulation time" (1978:204). There are many reasons for why the sale is harder than the purchase, but the main reason is the difference in social form, i.e. whether it is the commodity or money that is the point of departure for the movement. Being the universal equivalent and mirror of the value of all

¹²⁰ In *Capital Vol. 2*, Marx makes a similar case for how various circuits condition one another in terms of circulation and production time. Noting that earlier in this particular argument, he had assumed that circulation time of circuit X depended on X selling their commodities or receiving payment more quickly (i.e. reducing selling time $C'—M'$), Marx notes that reduction in circulation time could also come from "the second phase $M—C$, i.e. from a simultaneous alteration either in the working period or in the circulation time of capitals Y, Z , etc., which supply capitalist X with the elements of production of his fluid capital" (Marx 1978:365).

commodities, money is “directly exchangeable with all commodities” (Marx 1976:159). Formally, money capital’s movement has low latency.¹²¹

The commodity, however, is not in the form of direct exchangeability, and this formality alone makes the sale more difficult and take a longer time than the purchase. Before the commodity’s price can be realized in money, it must “stand the test of use-value” (Marx 1976:129). In other words, someone must have a need for the commodity, which is something that can never be guaranteed; even if there is a need for it, the potential buyer may not have enough money. Marx, therefore, refers to the commodity’s sale as a “*salto mortale*” (1976:200). While both sale and purchase represent a change in the form of capital, “C—M’ is at the same time the realization of the surplus-value contained in C” (Marx 1978:205). This realization is not the case with M—C. Therefore, Marx argues that “the sale is more important than the purchase” (Marx 1978:205). Thus while it is important to reduce both selling and purchasing time in order to increase capital's velocity, there is an added pressure to sell as fast as possible because the commodity is impregnated with surplus-value. For this reason, most of capital’s media are for commodity capital. Indeed, the only media for money capital I discuss in this dissertation is VISA’s payment system and the US check clearing system it remediated.

¹²¹ Apart from the problem of sourcing the correct quantity of means of production and labour-power, the purchase can, for analytical reasons, be treated as if it occurs automatically (Manzerolle and Kjösen 2015:164).

3 The Standard Container and Intermodal Transportation

Thomas Ehrlich Reifer (2007) suggests that if Marx were writing today, he would have started his analysis of capital not with the commodity, but with the standard shipping container, its contents, and the global network of social relations of which it is an integral part. He argues that the famous opening to *Capital Vol. I* would, therefore, have stated that wealth in capitalist societies “appears as an immense collection of containers” rather than commodities (Reifer 2007:1). While Marx would definitively do no such thing considering that the container box is a thing and not an economic category from which further categories can be derived, Reifer’s deficient Marxist acumen can be excused considering he is stressing the importance of the container to contemporary capitalism; the thrust of his argument is, therefore, well taken.

It is quite likely that Marx would consider the container and intermodal transportation the crowning work of twenty-first-century capitalism. Indeed, the importance of containers cannot be understated. As the core of a “highly automated system for moving goods from anywhere to anywhere, with a minimum of cost and complication on the way” (Levinson 2006:2), the container revolutionized the way freight is transported.¹²² Lifting detachable container boxes on container ships, train cars, and trucks are how most commodities are transported today. At any one time, there are about ten million containers simultaneously on the move on roads, railways, and on the seas, transporting ninety percent of “everything” (Easterling 2005:99; George 2013; Glück 2015:14). Containers are crucial for maintaining world trade, made the stretched factory possible, are the core of logistics as an optimized form of distribution, and are contributing to realizing the world market that is inherent in the concept of capital (Cudhay 2006:2; Levinson 2006; Reifer 2007:2; Cowen 2014b; Klose 2015:5). The container is not merely an adequate medium for the

¹²² When I refer to cargo or freight in this chapter, I treat it as a synonym for commodity capital.

mode of production but is arguably *the* medium for transporting commodity capital today.¹²³

In this chapter I discuss the material characteristics of the shipping container, how it, as a standardized object, revolutionized port productivity and integrated the previously separated modes of transportation of ship, train, and truck into a unified intermodal system. To demonstrate how this media system for transporting commodity capital is adequate to the logistical capitalism, I contrast it with breakbulk shipping and with specific reference to port productivity. After discussing intermodal transportation, I discuss the material characteristics of the individual modes of transportation and how they operate as a component of and made the intermodal system possible.

3.1 The standard shipping container

The shipping container is a rectangular steel box that is welded together, has a wooden floor and two large doors at one end (Figure 5). On its own the container is just an immobile box for storage; it has no engine, wheels, or sails to mobilize it. In this way, the shipping container is not that different from its pre-modern predecessors of chests, boxes, amphorae, and other types of containers that have been used for storage and transportation; since at least the Neolithic Age urns were used for the ashes of the dead, jugs as containers for supplies, and baskets as containers for transportation (Mumford 1966:140-1; Hine 1995:25-8; Klose 2015:129-30).¹²⁴ What sets the modern container

¹²³ Arguing that the container box is a medium is, of course, nothing new. For example, Bernhard Siegert (2007:30) argues that it is a prevailing cultural technique of the 20th and early 21st century and that its importance derives from being the modern answer to the ancient question of cultivation that constitute culture. Klose (2015) takes a media archaeological approach to the object, analyzes it from media-technological perspective in terms of transfer (transportation) and storage (preservation), and argues that it is an epistemological object that signifies “a change in the fundamental order of thinking and things that may be spoken of as a principle, the material core of which is the standard container” (2015:x). In a Kittlerian moment, he argues that the container was the technical a priori of Albert Einstein’s critique of Newtonian space as geometric, empty, and immutable. At the same time as “the concept of universal transport container began to take on concrete material forms,” Einstein’s refutation of Newton culminated in “the formulation of space as the container of all material objects” (2015:65).

¹²⁴ Unfortunately, it is beyond the scope and purpose of this dissertation to cover this fascinating history. For this history, see Mumford (1966), Hine (1995), Levinson (2006:29-35, 52-3), and Klose (2015).

apart from its historical counterparts is its: (1) orientatation towards systemic technologies; and (2) that its core structural element is standardization (Fuller 2005:93-8; Levinson 2006:31; Klose 2015:129, 137-8, 150).



Figure 5: Standard twenty feet shipping container (© BLS Containers)

Early containers were built for the human scale, meaning that they were made for human hands and strength; they were therefore equipped with grips, tabs, buttons or handles, and weighed no more than what a human being or another beast of burden was capable of carrying or pulling (Klose 2015:138, 150). Moving pre-modern containers matched human physiology and only required what Paul Virilio (2005) would refer to as the metabolic power of human and non-human animals. The modern standard shipping container dwarfs the scale of early containers: it measures 20 feet in length, 8 feet in width and 8.6 feet in height, and weighs 2.3 tons when empty and up to 30 tons when full. Due to these material characteristics, the modern container is oriented towards systemic technologies rather than the human scale; discharging, loading, and moving a shipping container require the technological power of cranes, ships, trains, and trucks. While this technological orientation contributed towards revolutionizing the way freight is handled and transported, it was dependent on the container's standardization (Cudhay 2006; Levinson 2006; Martin 2013; Klose 2015; D'eraimo 2015:91). Understanding how

and why the container is an adequate medium of transfer for commodity capital requires a discussion of the container as a standardized object.

3.1.1 Standards

The modern shipping container is a highly specialized object; it is defined in almost every detail by the International Standards Organization (ISO). As Geoffrey Bowker and Susan Star argue, standards are “any set of agreed-upon rules for the production of (textual or material) objects” and thus operate as guarantees for stability across both time and space (2000:13). In this way standards are means by which specific realities are constructed; the standard container arguably created the material and socio-economic reality of international freight transportation (Busch 2011:166-70). Moreover, as Armand Mattelart argues, a “standard is that which allows parts to be integrated into a whole” (2003:17). One of the main things that standards enable is interoperability between technical systems. Before the advent of the standard shipping container, the different modes of transportation (ship, train, and truck) were functionally separate and consequently contributed to why the means for handling pre-containerized cargo were a fetter on the mode of production. More importantly, “to be able to process material efficiently, standardized sizes and forms are necessary” (Klose 2015:324). As a standard object, the shipping container guaranteed that it could be handled in the same way anywhere in the world, which allowed for the integration of the modes of transportation, development of complementary technologies (like truck chassis and double-stacked rail cars), and rationalization of port productivity.

The ISO has determined the details of the container and its transport according to dimensions, materials, maximum weights, technical details of the handling process and so on (2013; Levinson 2006:137-49; Klose 2015:51-4). Since 1961, the ISO’s technical committee on freight containers has published a total of forty-five standards under its direct purview (ISO n.d.). The main standards refer to the container’s size and shape (dimensions), maximum weight, the strength of corner posts, door openings, the design of floors, and so on (ISO 2013). Standardizing these elements was necessary for several reasons. For example, standard dimensions are required for secure stacking on ships, railcars, and in ports; a diversity of dimensions would lead to empty spaces between

stacked containers which could prove disastrous for ships in high seas. Standard dimensions and weight limitations were also necessary for the development of complementary technologies like container ships, the double stacked rail car, truck chassis, and cranes.

Although 40 and 45-foot long containers are also standard, the 20 feet long, 8 feet wide and 8.6 feet high container with a carrying capacity of 1,172 cubic feet and a payload capacity of 30.1 tons as shown in Figure 5 is the recognized standard. The twenty-foot equivalent unit (TEU) is also the standard measure of cargo capacity for container ships and terminals. Today, however, the forty-foot container (2TEU or FEU) is more common (Cudhay 2006:41).¹²⁵ The majority of containers are constructed to carry dry cargo and represent 93% of the global container fleet, which in 2012 reached 32.9 million TEUs. The remainder of the fleet is split between insulated refrigerated containers (“reefers”) and tank containers (“tanktainers”) for transporting both hazardous and non-hazardous liquids, gases and powders. Reefers, as depicted in Figure 6, have an internal refrigeration unit, but require external electrical power from a land-based site or the vehicle that hauls it. These special containers are capable of controlling their internal temperature in a range from -30°C to 40°C. As shown in Figure 7, a tanktainer consists of a standard container’s steel frame and an insulated stainless steel tank or multiple steel bottles. It has a capacity of between 27,000 to 40,000 liters.

¹²⁵ There are variations on the internal dimensions of standard containers constructed for specific types of cargo, such as for palletized commodities or for handling garments on hangers. There are also different types of standardized containers, including so-called “high cubes” that measure 9 feet by 6 inches high. The forty-foot container is more common because they can be pulled by a semi-trailer, is more economical for trucking than the twenty-foot container, and is within the limits of most national road regulations. The 45-foot container is also considered 2TEU (ISO 2013).



Figure 6: Refrigerated container showing refrigeration unit (© 2009 Sarah Klunge)



Figure 7: Universal tank container (Creative Commons BY-SA 3.0 TCC1)

Two key standards that also contributed to interoperability and the integration between different modes of transportation and lifting equipment are the container's corner fittings and twist locks, which are the systematic technological equivalent of pre-modern handles, grips, and buttons. Brian J. Cudhary argues that it was the corner fittings that “permitted the extraordinary degree of interchangeability that remains a hallmark of the contemporary container industry” (2006:40); Marc Levinson considers the twist lock to be “the most critical invention of all” (2006:56); and Alexander Klose (2015:122) points

to both standards as what distinguishes the shipping container from its historical antecedents. These two simple pieces of equipment are vital for lifting containers and securing them to truck chassis, rail cars, and to other containers when stacked during transit on sea or stored on land (ISO 1984). As Figure 8 shows, the corner fittings are six-inch cubes, each with an oblong opening on its three surfaces facing outward. With the corner fittings incorporated into the container's body with four both on top and the bottom, they allow for gantry cranes and other lifting equipment to secure a reliable hold while moving the container on and off ships, trucks, and trains.



Figure 8: Corner fitting

Securing the containers, whether to each other, a truck chassis or a railcar requires metal twist locks to be inserted into the top corner castings of the bottom of the container and the bottom casting of the top container. The twist lock (Figure 9) is a toggle that when locked, as shown in Figure 10, securely joins containers to a vehicle or to other containers to form a vertical stack that will remain a unified structure even during rough ocean voyages (Cudhay 2006:39; Levinson 2006:56).



Figure 9: Twist lock



Figure 10: Stacked and locked containers

Without standardization, containerization would not have made the means of communication and transport adequate to logistical capitalism. But what makes the media system of the standard container adequate to capital in its logistical period? How precisely does it contribute to the mode’s elasticity? Answering these questions requires a discussion of the effects of the container’s standardization and orientation towards systematic technologies on port productivity, which first requires a discussion of why the previous media system for moving freight—breakbulk shipping—proved to be a fetter on the mode of production.

3.2 Breakbulk shipping

The standard container is a very recent development in the history of shipping. Although Marx argued that the means of communication and transport have developed in step with changes in the mode of production—his examples of railways and ships are based on the introduction of the steam engine and new methods for building ships in materials other than wood—how cargo was actually transported over sea, but in particular how it was handled in ports, had not merely been, to use Marx’s words, “handed down” from the preceding Fordist period, but from pre-capitalist modes of production. As late as 1969, cargo ships had their cargo loaded and discharged in a process that was not that different from how Phoenician trading vessels were turned around in ports about 3,000 years earlier (Levinson 2006:16, 212; Klose 2015:88).

Although breakbulk vessels and the dock that served them were adequate to the Fordist and earlier periods of the capitalist mode of production, they proved to be fetters on the emerging logistical period; prior to the maturation of the standard container in the, production was largely a domestic affair and the volume of international shipping until the 1980s was low (Lynn 2005; Levinson 2006:3). The reason why the maritime means of communication proved inadequate was, however, due to how cargo was handled in ports and during modal changes in transportation.

In shipping, there are three different types of cargo that each require both separate vessels and handling: bulk, breakbulk, and containerized. While bulk cargo is qualified as indiscriminate and refers to goods that are homogenous (e.g. grains, coal, and oil), breakbulk cargo is characterized by its diversity and consists of discrete use-values with a bewildering variety of shapes, sizes, fragility, and possible configurations (Cudhay 2006:9).¹²⁶ Breakbulk cargo consists of the natural forms of individual commodities (e.g. a vehicle or industrial machinery) and different types of containers and packaging (e.g. barrels, boxes, bales, and sacks) that subsume the natural forms of commodities. This cargo had to be painstakingly loaded and unloaded piece by piece into and out of the holds of ships, rail cars, trucks, and when the cargo was placed in or retrieved from storage.

The complicated breakbulk shipping process started at the shipper's factory or warehouse where commodities first had to be loaded piecemeal into a port-bound truck or railcar; at the port, the cargo was unloaded piece by piece and tallied and recorded before it could be carried to a temporary storage shed. When a breakbulk ship was ready to be loaded, each item would be tallied and registered again before being taken shipside where

¹²⁶ Indiscriminate bulk is often (and confusingly to the Marxist), referred to by mainstream economists as commodities. Hence, in economics today commodity refers to goods that are homogenous rather than a social form that goods are stamped with in the process of social (re)production. In media theoretical terms, bulk cargo is analog in that it allows for continuous loading and unloading (e.g. with a conveyor belt or spout), while breakbulk and containerized cargo are both digital in that they consist of discrete units than must be loaded individually. The term "breakbulk cargo" comes from how it is handled; "breaking bulk" refers to the beginning of the unloading process from a ship's hold or the extraction of a part of the cargo.

longshoremen, having just emptied the ship's holds of its previous cargo, would reload the item by item (Levinson 2006:16-18). While this process was partially automated with the use of forklifts and equipment like netting and manual cranes, it was primarily done by hand and the metabolic strength of human labour power (Cudhay 2006:8-9; Levinson 2006:18; Bonacich and Wilson 2008:50). In the holds, longshoremen took particular care in stowing the cargo to maximize space and ensure that it was stowed securely to avoid damage to both cargo and the ship, and the risk of capsizing (Cudhay 2006:27-8, 104; Levinson 2006:17-8). When the ship reached its destination port, the entire cargo had to be discharged and loaded again in the same manner as just described.

Due to this complicated process, all breakbulk vessels spent a long time in port. Cargo ships steaming the transatlantic route, for example, would spend as much time unloading and loading in ports as it did on sea (Cudhay 2006:9). Given the time and labour required, the highest cost of ocean shipping was consequently port related. A 1954 study by the US National Research Council revealed, in the words of Levinson, "just how backward cargo handling was" (2006:33). Focusing on the cargo ship *The SS Warrior's* voyage from Brooklyn to Bremen, the study found that

the ship spent half the total duration of the voyage docked in port. The last of its cargo arrived at its ultimate destination 33 days after the *Warrior* docked at Bremerhaven, 44 days after it departed New York, and 95 days after the first Europe-bound cargo was dispatched from its U.S. point of origin (Levinson 2006:34).¹²⁷

Of the total cost of \$237,577, the voyage accounted for only 11.5 percent. The study concluded that "perhaps the remedy lies in discovering ways of packing, moving and stowing cargo in such a manner that breakbulk is avoided" (in Levinson 2006:34-5). Placing cargo in a standardized container was that remedy.

¹²⁷ The vessel was loaded with 194,582 individual items of different sizes and description (including food, household goods, machine parts, and 53 vehicles) for a total of 5,015 tons of cargo. This cargo had arrived in Brooklyn in 1,156 different shipments from 151 US cities, with the first shipment arriving a month prior to the ship's departure. Longshoremen working one 8-hour shift per day, required 6 days to load the ship; steaming across the Atlantic took ten and a half days, and unloading in Bremen took 4 days by longshoremen working around the clock (Levinson 2006:33-4).

3.3 Containerized shipping

Klose argues that the ISO container is “a universal, indifferent transport unit” (2015:200). It is indifferent towards its contents and therefore also towards the various modes of transportation. What is inside the containers is irrelevant, be it fast fashion, HDTVs, e-waste, immigrants, or a dirty bomb. As opposed to classical cargo transport, there is no need to choose between or deal with the numerous natural forms of individual commodities that differ in shape, weight and fragility. Like money, albeit materially rather than socially-abstractly, the container erases the qualitative differences between commodities; inside the container all their sensuous characteristics are extinguished, which means that their natural forms can be ignored and are of concern only at the beginning and the end of the transport process (Levinson 2006:7; Klose 2015:99-100, 219, 316).

As opposed to the breakbulk era, individual commodities are no longer transported, but containers are. And despite their standardized variations, one container is equal to all others. When cargo is placed in the container, and because it is standardized and oriented towards systemic technologies, the container is the “concrete materiality of the transport process” (Klose 2015:79). The container effectively rendered the diversity of commodity capital’s diverse natural forms obsolete as a problem in shipping and with that enabled the means of transportation to become adequate to the mode of production. With reference to how the container increased port productivity and integrated the formerly separate modes of transportation into a unified system, I now discuss how specifically the container and its system is adequate and how it contributed to giving the capitalist mode of production in its logistical period elasticity.

3.3.1 Port operations and productivity

A maritime container port consists of one or more container terminals where containers are transshipped between different modes of transportation and routed to an intermediate destination, such as an inland container terminal or distribution center. Dirk Steenken et al. (2004:6-7) describe maritime container terminals as “open systems of material flow” with a quayside and hinterland “operation area” where the unloading and reloading of

ships, trucks, and rail cars respectively occur. As Figure 11 shows, the quayside and landside operations are “decoupled” by the port’s yard where both containers are stored in stacks of empties or for import and export, and has areas reserved for special containers like “reefers” that require electrical connections (Steenken et. al. 2004:6).¹²⁸

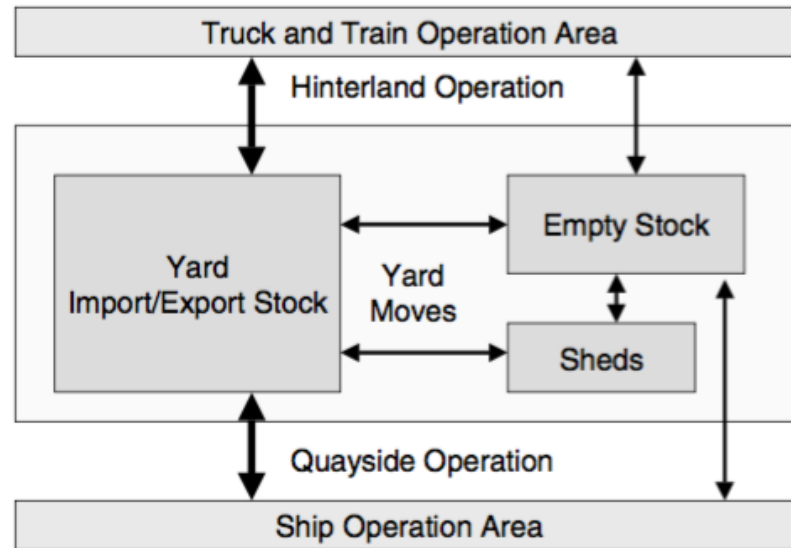


Figure 11: Operation areas of a maritime container terminal and flow of transports (Source: Steenken et. al. 2004:6)

When a container ship arrives in port, it is assigned one of several berths in the quayside operation area, each equipped with enormous rail-mounted gantry cranes sufficiently powerful to lift and move a full, 30-ton container on and off the vessel. As shown in Figure 12, these cranes are massive steel structures that may extend as much as 200 feet into the air and have legs up to 50 feet apart for truck lanes and/or rail tracks to pass beneath. They move on rails running parallel to the vessel’s side in order to move forward or back as required. For loading and unloading, the cranes extend a boom long

¹²⁸ The yard may in addition have a temporary storage shed where containers are de- and reconsolidated, although unpacking the cargo in this way is an activity that for the most part has moved to distribution centers miles inland (Steenken et. al 2005:6; Levinson 2006:203).

enough to span the width of ships which may be up to 180-feet across.¹²⁹ With its “spreader”—a rectilinear steel frame with the same length and width as a standard container—it can pick up a container by securing a hold on its corner fittings. As Figure 13 shows, containers departing or arriving by rail are handled by similar straddle cranes that span several rail tracks and move up and down the length of the train when loading and unloading.



Figure 12: Rail-mounted cranes stacking containers on truck chassis (Source: O’Reilly 2011)



Figure 13: Rail-mounted train stacking cranes (Source: Tirschwell 2015)

¹²⁹ The ship’s data will specify the required dimensions of a crane’s height and boom length.

Horizontal transport between quay and stack or hinterland and stack is done with trucks, trailers, automated guided vehicles (AGVs), or straddle carriers. Container stacking and their reshuffling are done with stacking cranes, which may be gantry cranes or straddle carriers. The internal movement and reshuffling is also done by different types of cranes, including top-pick empty handlers, reach stackers, side loaders, and straddle carriers. So-called “assisting systems” of computers, (differential) global positioning systems (GPS), and electronic data interchange (EDI) are used for identifying the position of containers and communicating between terminal operators, shipping lines, truck and rail companies, customs, and other parties (Steenken et. al. 2004:6-12; Cudhay 2006:39-40; Levinson 2006:4-5; Bonacich and Wilson 2008:52). Figure 14 depicts a schematic of a maritime container terminal’s delineated media system and how containers move within such a terminal.

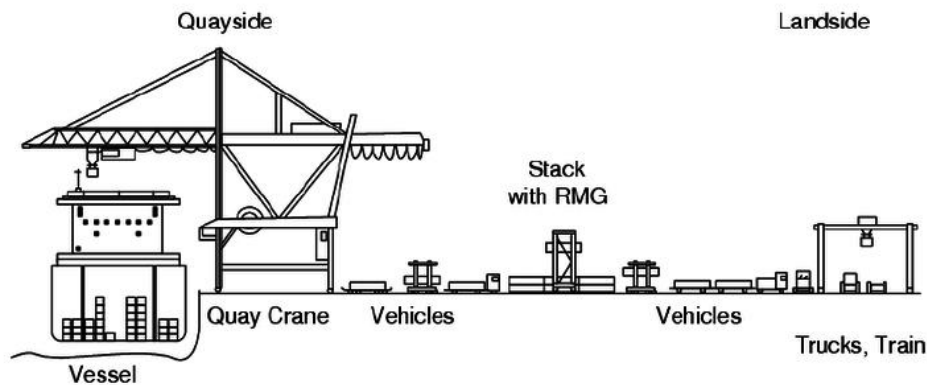


Figure 14: Schematic of container terminal system (Source: Steenken et. al. 2004:13)

The entire movement of containers, cranes, trucks, trains, and the few remaining longshoremen at ports is scheduled and choreographed by specialized software prior to a vessel berthing; this schedule is updated in real-time throughout the discharge and loading process.¹³⁰ The stowage of a container ship, i.e. the position for all containers, is

¹³⁰ This software is designed for simulating and optimizing the movement of containers through a terminal. This optimization is essential because, as opposed to the breakbulk method, discharging and loading ships occurs simultaneously with containers. After placing an incoming container on a truck or train car, the crane will pick up a container from another truck (Levinson 2006:4-5).

programmed in advance by the shipping line and transmitted by EDI to the terminal operator. Railway companies will produce and transmit similar, albeit simpler, plans for loading trains (Steenken et. al. 2004:16-19, 31; Levinson 2006:6).¹³¹ Unloading and reloading container ships are done by a crane operator following instructions on a monitor in the crane's cabin which indicate what container to be pick up next and where:

The computers have determined that the truck picking up incoming container ABLQ 998435 should be summoned to the terminal at 10:45 a.m., and that outgoing container JKFC 119395, a 40-foot box bound for Newark, carrying 56,800 pounds of machinery and currently stacked at yard location A-52-G-6, will be loaded third from the bottom in the fourth slot in the second row of the forward hold (Levinson 2006:6).¹³²

Depending on the port's productivity, this process is repeated every two minutes or ninety seconds. Although a crane has the technical capacity of moving between 30 to 40 containers per hour, the actual performance is typically lower because of pauses, breaks during shifts, lashing of equipment, and congestion due to horizontal transportation. A general aim of ports is therefore to enhance crane productivity, i.e. to come as close as possible to the crane's technical capacity (Steenken et. al. 2004:8; Levinson 2006:4-5).¹³³

¹³¹ According to James W. Cortada (2004), the principle of intermodality is not merely the merger of different modes of transport through the container box but also and importantly through information technology. Frank Broeze concurs, arguing that containerization was so dependent on electronic data processing that computers paradoxically formed the software of the container system. In particular, computerization was necessary for calculating the optimal loading of ships—considering their various destinations, weights and centers of gravity—and for handling the paperwork complementing the movements of each container (Broeze 2002:23f). Prior to computerization and the internet, the transportation of commodities often proceeded faster than the necessary paperwork, with the result that containers could be ready for shipment at ports but without the required papers. With the internet, the transmission of documentation was accelerated (Klose 2015:224-5).

¹³² Following these instructions, the crane operator moves the boom to a precise location above the ship, lowers the spreader to “engage” a container, lifts it and pulls it quickly towards the wharf where trucks or trains are waiting to receive the container. The container may be taken to an adjacent storage yard or be transported directly to its next destination. To be placed in the storage yard, incoming containers are driven below stacking cranes with wheeled legs 50 feet apart, a width enough to span a truck lane and four adjacent stacks of containers. Standing 70 feet in the air, the stacking crane can move back and forth over rows of containers stacked six high (Steenken et. al. 2004:6-7; Levinson 2006:5).

¹³³ In 2013, the world's most efficient container terminals were APM Terminals at Yokohoma port (Japan) and Xingang Sinor Terminal at Tianjin port (China), each with a berth productivity of 163 container moves

As with all machinery, the container, cranes, and other shore-side equipment just described increased the productivity of labour in ports; more cargo could be discharged and loaded at the same time than before and with less labour, which reduced both the time and cost vessels spent in ports. Whereas breakbulk vessels could require up to 150 or more longshoremen working a minimum of four days to a week to unload and load a ship, the process with a container could be completed over a single eight-hour shift by a crew of just fourteen or less. Due to the container's standardization and orientation towards systemic technologies, terminals are therefore characterized by a high degree of automation. Instead of spending half of its time in ports, a container ship could reduce this to just 10 to 20 percent (Levinson 2006:34; Bonacich and Wilson 2008:52).¹³⁴ From the vantage point of circulation, this massive increase in productivity significantly reduced the maritime circulation time for capital.

After being unloaded and moved to the landside operating area, containers are placed on truck chassis or rail cars. On trucks, containers depart through the port's gates and are typically destined for an inland distribution center. On double-stacked rail cars, the outbound containers are intended for railyards miles away, like the Chicago rail exchange, and will only make the briefest of stops (Levinson 2006:6). As Levinson explains, the result of all of this hectic port activity is

a nearly seamless system for shipping freight around the world. A 25-ton container of coffeemakers can leave a factory in Malaysia, be loaded aboard a ship, and cover the 9,000 miles to Los Angeles in 16 days. A day later, the container is on a unit train to Chicago, where it is transferred immediately to a truck headed for Cincinnati. The 11,000-mile trip from

per ship per hour or one container every 22 seconds (UNCTAD 2014:68). A berth will have several cranes for the discharge and reloading process.

¹³⁴ As early as 1975, the steamship line Oceanic Container Line (OCL) compared the statistics on time spent at sea and ports of the *Encounter Bay*—an all-container ship—with break-bulk cargo ships. While the *Encounter Bay* spent 300 days of its first year on sea and 65 days in port, the most modern break-bulk cargo ship operated by OCL spent 149 days in port and only 216 days on sea (Cudhay 2006:104).

the factory gate to the Ohio warehouse can take as little as 22 days, a rate of 500 miles per day, at a cost lower than that of a single first-class air ticket. More than likely, no one has touched the contents or even opened the container, along the way (2006:7).

I now turn to this seamless system and its individual parts.

3.4 Intermodal transportation

By 1965 the diversity of container sizes and shapes was beginning to be standardized out of existence. Leasing companies had started investing in the production of standard containers, and most ship lines had started using interoperable containers. With a standardized container, the reduction in both the cost and time that vessels spent in port meant that international container shipping could become a reality (Levinson 2006:149). Initially, however, the time, labour, and costs saved by ocean shipping and efficient ports were not enough to significantly reduce the total cost of delivery, which remained quite high. It was not until the container caused chain reactions in the other branches of transportation that a system emerged for moving commodity capital quickly, with little complication, and at a minimum of cost. The standard container had, to use a phrase of Marx's, to "call forth" specific inventions in rail and trucking that would lead to the advent of intermodal transportation. Before I turn to these specific inventions in rail, shipping, and trucking, I briefly discuss the intermodal system.

Before the standard container, the different modes of transportation were effectively silos, with each mode having a clearly defined function: steamship companies moved freight between ports, the railways between rail yards, and with trucking taking care of the rest (Bonacich and Wilson 2008:53). Moreover, because these modes were isolated, modal changes were break-in-bulk points and therefore contributed to the overall cost and duration of freight transportation. During the breakbulk era, transit was therefore effectively broken. Increasing the overall speed and efficiency required "a bonding agent" that would transform breaking points into points of connection (Klose 2015:181). The standard container was, of course, this agent.

As Klose explains, a consequence of the container was that any mode of transport participating in its system had to re-organize irrespective of how this mode had

previously developed. By placing itself between them, the container turned the previous break-in-bulk points into points of connection and thus made a united system out of the previously disparate parts (2015:46-7, 181).¹³⁵ Indeed, the basic concept of the container is that it enables the *seamless movement* of cargo between the different modes of trains, trucks, and ships (Levinson 2006:260; Klose 2015:45). In other words, the intermodal transportation system emerged as a result of the standard container.

In general, intermodal transportation refers to “the use of at least two different modes of transport in an integrated manner in a door-to-door transport chain” (OECD 2001:7). It is only when the container is the concrete materiality of the transportation process, however, that no cargo is actually handled during modal changes so that a “container can be packed at a factory in Asia and unpacked only when it arrives at a warehouse in Chicago” (Bonacich and Wilson 2008:14).¹³⁶ More importantly to develop a concept of capital’s media, it is only in so far as the shipping container is a component of the intermodal system that it functions as a medium of transfer for commodity capital.

The concept of the “(intermodal) land bridge” is perhaps the best example of the benefits of intermodal transportation. This concept refers to a container travelling on both ship and train as part of a single shipment (Cudhay 2006:163). Specifically, it means shipping containers over a body of water in a container ship, the unloading of the containers on a body of land and onto rail cars for their transportation over land until it reaches another port where a second container ship finishes the route. (SCM Wiki n.d.; Vitasek 2013:112).¹³⁷ While land bridges exist worldwide, the first example referred to the

¹³⁵ While this re-organization can be thought of in Marxist terms of how revolutions in one branch of production have ripple effects in related branches, Klose views the container as a Serresian parasite that makes a system out of the relations it forms with other beings (2015:181; see Serres 2007).

¹³⁶ Intermodalism has become nearly synonymous with containerization (Wood et. al. 2002:203). When I refer to intermodal transportation or a synonym, I always also mean containerization.

¹³⁷ If the containers end their journey after crossing the landmass, i.e. are not loaded onto a second ship, the land bridge is referred to as a ‘mini land bridge’. Mini land bridges are movements of containers that are unloaded on the East Coast, but do not make any further voyages on sea, while micro-land bridge refers

shipping of containers across the continental United States (SCM Wiki n.d.; Cudhary 2006:165). Figure 15 shows the different possible North American land bridges. The benefit of using land bridge to move cargo is that it greatly accelerates the movement of cargo and reduces the costs of circulation. The typical route for moving commodities from Asia to the US East Coast used to be through the Panama Canal, which, due to ships having to navigate the different sets of locks comprising the 51 miles of the canal, added a week or longer to the overall journey. While it takes about thirty days to complete an all-water service from South East Asia to the US East Coast and back via the Panama Canal, berthing at a West Coast port and using a land bridge may reduce circulation time by a week (Cudhary 2006:165; Bonacich and Wilson 2008:53).



Figure 15: The North American land bridge (Source: Ashar and Rodrigue 2012)¹³⁸

to movements that terminate on US territory before reaching the East Coast (Bonacich and Wilson 2008:53-4).

¹³⁸ The Mexican land bridge going from the West Coast port of Manzanillo to the East Coast's ports in Altamira and Veracruz is not shown in Figure 15.

3.4.1 Trains, railroads, and the double-stacked rail car¹³⁹

Using land bridge to move commodities faster and more efficiently from Asia to the US East Coast was not possible until the railways could achieve economies of scale with containerized cargo. In both the United States and Europe since the 1920s, trucks were moving the majority of freight due to their flexibility relative to the railways and despite being a more expensive mode of transportation (except for shorter distances). The huge volume of container shipping was not advantageous to trucking because a truck can pull only the equivalent 2TEU. For the railways, however, this volume was advantageous because it promised the benefits of economies of scale; it costs little extra to pull another container once the train is running. But because the existing flatbed rail cars could only carry 1-2 TEU, achieving economies of scale was impossible until the standard container “called forth” a crucial invention—the double-stacked rail car.

Although containers were designed to be stacked on top of each other, the way in which conventional railroad flatcars were designed precluded such stacking due to height clearances along the right-of-way. The key feature of the double-stack rail car—invented in 1977 by Southern Pacific Railroad—was, therefore, its lowered floor between the running gear, which allowed for the stacking of containers while still respecting height clearances.¹⁴⁰ As this specific technology has developed, the floor was replaced with a well-like structure, hence, why intermodal railcars, as depicted in Figure 16, are today referred to as “well cars.” More specifically, a well-car is made up of five separate cars that are linked together to form a permanent unit in order to avoid car-to-car vibrations, but which is nevertheless able to bend while in transit (Cudhay 2006:162-4; Wood et. al.

¹³⁹ This section’s discussion is based on North American railroads where intermodal container trains are the most common. Such trains are, however, also in use in Europe and Asia. For example, container trains run on the tracks connecting the Port of Rotterdam to 22 European cities, primarily in Austria, Belgium, France, Germany, Italy, Poland, and Switzerland (Wood et. al. 2002:211). A reason for why container trains are more common in the US is due to the size of the landmass compared to Europe.

¹⁴⁰ Depending on the right-of-way, height limitations vary between 18 feet and 2 inches to 20 feet and 2 inches, but this clearance is sufficient for even double-stacking high-cube containers. In North America where double-stacked cars are the most common, railroad companies have invested considerably in raising bridges and tunnel clearances along their right-of-way to allow for greater use of these specialized rail cars.

2000:208-10; Smil 2010:143). Double-stack cars conform to the standard sizes of the containers; they are typically 40 feet in length, which means it can carry 4 TEU; carry two 20-foot containers or one 40-foot container in the drop-centered bottom, and two 20-foot container or one 40-foot or longer container on top (Wood et al. 2000:209). Since 1984 trains have been put together entirely with well-cars. Depending on the locomotive, the trains can be up to 150 railcars long for a capacity of up to 600 TEU. It was first with this increased capacity that economies of scale were achieved by the railroads and that shipping by rail became competitive with coastal transport and continental circumnavigation due to cutting the cost of land bridge by half (Levinson 2006:170; Bonacich and Wilson 2008:98; Klose 2015:107).



Figure 16: Double stacked well cars (Creative Commons BY-SA 2.0 Sean Lamb)

Intermodal trains are pulled by locomotives with diesel engines as their prime movers (Smil 2010:141).¹⁴¹ While these locomotives are capable of speeds up to 300 km/h, the regulated speed limit of US freight trains (dependent on the signaling system used, track

¹⁴¹ As Vaclav Smil explains, these engines' reciprocating motion is not transmitted to the wheel, but generates electricity for the electric engines that mobilize the train. The most powerful of these engines have about 4,300 horsepower and a tractive effort of up to 75 tons (2010:141). Tractive effort refers to a locomotive being able to overcome the train's resistance to motion (inertia, axle-bearing and wheel friction, and gravity if on an incline) in order to start a train and accelerate it to a given speed.

condition, and the physical conditions of trains) is 79 km/h. Average speeds, however, are declining due to operational problems, congestion at terminals, the lack of double tracks at many of the most trafficked routes, and because the capacity of the railroads is nearing its limit due to the sheer volume of intermodal shipping (Bernstein 2004; Bowen and Slack 2007:37-8).

With the double-stack railcar, shipping by rail became the mode of choice for imports passing through ports and cheaper relative to trucking over long distances. A drawback of railroads is, however, that they can only pick up and deliver cargo at rail terminals, from which trucks must haul the cargo to its end points (Bonacich and Wilson 2008:101). The double-stack railcar effectively determined the respective roles of trains and trucks in this media system: while the former handled long-hauls, the latter would do short-haul work. According to Levinson, an additional effect of the well-car and the emergence of the land bridge was improved scheduling: “a shipper a thousand miles from the sea would be able to buy not just international transportation but tightly scheduled intermodal transportation. A seller could tell its customers when the goods were to arrive, with a reasonable likelihood that the schedule would be met” (2006:169).

Intermodal trains are, of course, not the only component of the railroad media system for moving commodity capital. As in Marx’s time, albeit with some modifications, this system consists of the infrastructure of railways, tunnels, bridges and intermodal rail yards, and in addition to railcars, the diesel-electric locomotive. In 2005, the US’s class 1 railroads had about 150,000 km of track, on which operated about 24,000 locomotives (Smil 2010:141).¹⁴² Figure 17 shows the North American intermodal rail network and thus the routes commodity capital moves along after entering the continent in containers. Due to land bridge, rail freight in the US is primarily “articulated along major latitudinal corridors linking the two major gateway systems... Southern California and New York/New Jersey via Chicago” (Rodrigue and Hesse 2007:116). As Figure 17 shows,

¹⁴² In Canada and the US, and in opposition to most other phenomena belonging to the general conditions of production, most intermodal rail infrastructure is privately financed and maintained rather than publicly funded. The railroads are, however, subject to the laws of common carriage.

Chicago is a vital hub in this network; the city contains over 30 rail terminals alone (IANA 2014). These tracks are operated by nearly 1200 intermodal rail terminals where containers are unpacked and reconsolidated for further transportation on trucks or loaded onto a truck or a different train. In relation to supply chains, the operation of the rail (and road) system is to link ports with points of production and exchange (Rodrigue and Hesse 2007:114).

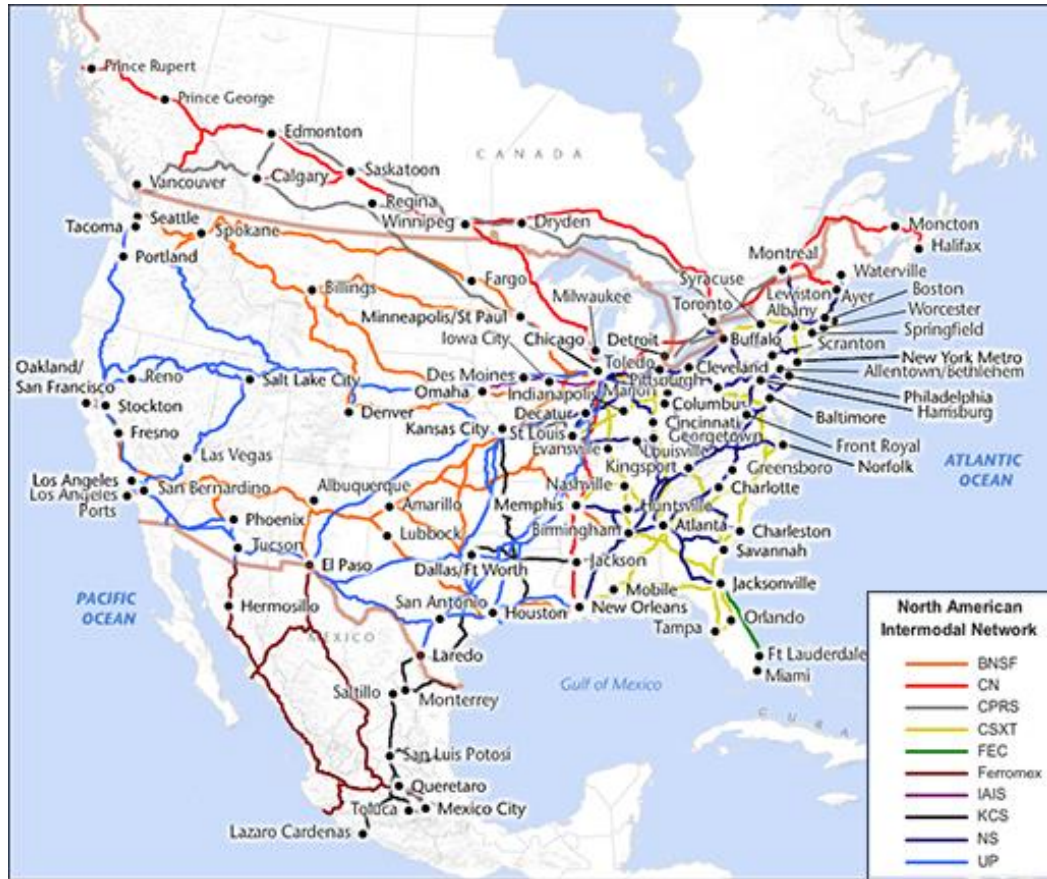


Figure 17: Intermodal railroad network (Source: IANA (2014))

3.4.2 Trucks, trucking, and container chassis

There are four distinct sectors of trucking: (1) the truckload (TL) sector which engages in filling entire trailers with cargo of one company and transports it in a single haul from origin to destination without stopping; (2) the less than truckload (LTL) sector which consolidates cargo from several companies in a single truck by making several stops in the haul; (3) the small package delivery sector by companies such as UPS and FedEx;

and (4) the drayage sector which uses chassis to haul disconnected trailers (Bonacich and Wilson 2008:102). Out of these four sectors, drayage is the only one directly connected to intermodal transportation in the sense that it is the container that is moved. Trucking is naturally dependent on the existence of a network of highways, tunnels, and bridges; the United States has 4.3 million km of roads with the interstate highways system comprising 77,000 km (Rodrigue and Hesse 2007:116).

The role of the TL and LTL sectors is only indirectly connected to intermodal transportation because they move cargo after it has been unpacked from containers (Bonacich and Wilson 2008:102). While rail moves the majority of intermodal containers, the trucking sector hauls the majority of domestic cargo, has a large share of small and/or high-value commodities, is the mode of choice if time is of the essence, and operates at either end of intermodal movements. Trucking is more flexible than rail in the sense that it can react quicker than trains that follow set schedules; just-in-time distribution often requires smaller but more frequent shipments which also favours trucking (Bowen and Slack 2007:20-1; Bonacich and Wilson 2008:99-101; Wood et. al. 2002:212).

Drayage companies pick up containers at ports and haul them to a rail terminal, pick up containers at rail yards for delivery to the final customer, or haul domestic containers filled with transloaded cargo from an inland distribution center to its next destination. For trucks to move shipping containers, however, they must be placed on chassis—wheeled trailers—which are required to haul them securely. The trucking equivalent to the double-stacked rail car is, therefore, the container chassis. As Figure 18 shows, this chassis is specifically designed for containers; the pins at each side of it fit into a container's corner fittings. On a highway, the truck appears as a conventional trailer. While there is not much more to say about the operation of this particular component of the intermodal media system, the truck chassis is a good example with which to consider what occurs when a key component of the system is missing.



Figure 18: Truck chassis (© Megaship Logistics)

From late 2010 to late 2014 there was a “chassis crisis” in the United States that contributed greatly to reducing port productivity; at the already congested ports of Los Angeles and Long Beach (LA/LB) delays of eight to fourteen days have been attributed to missing chassis (O’Reilly 2011; Mongelluzzo 2014). The chassis crisis was, in general, an effect of a lack of roadworthy chassis, but in ports, the crisis was due to the particular problem of chassis dislocations.¹⁴³ A particular problem was “split delivery,” where the container goes to one terminal and the chassis to another. Because no one is willing to pay for the repositioning of the chassis to another location, it is typically left where the container was delivered. Without access to chassis, container ships cannot be effectively discharged because the containers are not moved out of the terminal, but instead back up leading to further congestion and reductions in productivity. For

¹⁴³ This scarcity was thus in part a problem of chassis logistics, i.e. of making sure that they are at the right time and place, and in the right quantity. The crisis was, however, precipitated by the US Federal Motor Carrier Safety Administration (FMCSA) passing and enforcing stricter regulations for inspecting, repairing, and maintaining container chassis. Chassis used to be provided to terminals by the steam ship lines, but due to the new regulations and in general recognizing that supplying intermodal equipment was not a viable business, they decided to no longer provide chassis. The crisis was initially caused by the steam ship lines selling off their chassis and the following problem the new leasing companies had with establishing use agreements with the former owners of the chassis (O’Reilly 2011; Mongelluzzo 2014).

example, at the port of Long Beach lack of chassis resulted in a drop in two container moves per crane per hour (Mongelluzzo 2014).¹⁴⁴

3.4.3 Container ships

From a ship design perspective, precisely knowing the cargo is important because space aboard ships, measured in cubic footage, has always been precious and limited. A lot of a breakbulk vessel's capacity was wasted due to the irregular shapes and sizes of the cargo (Cudhay 2006:27-8). That container ships carry only standard containers changes how cargo ships are constructed. While breakbulk vessels were designed with flexible space for the diversity of their cargo, when the container is the starting point, the ship is built around it (Cudhay 2006:104).¹⁴⁵

Container ships are designed with efficiency in mind, in terms of their capacity (as measured in TEU), their steaming speed and fuel consumption, and how quickly they can be turned around in ports. The hull of a container ship is built around a strong keel, and together they form a frame into which below-deck cargo holds, fuel tanks and the aft engine room are set. The cargo holds are constructed for the efficient discharge and loading of containers, and to keep containers secure during steaming. There are two key components that aid this functionality. First, the vital “cell guides”—vertical rails made out of metal that are 1.25 inches longer and 0.75 inches wider than the container it will hold— are installed in a ship's cargo holds for guiding the loading and unloading process and stacking containers into rows (see Figure 19).

¹⁴⁴ A similar problem occurs with containers as well. Due to the problem of imbalanced volume of freight to and from Asian ports containers may be left where they were emptied if cargo cannot be found for the return journey; and in the US containers may be left where they were emptied (Bonacich and Wilson 2008:80).

¹⁴⁵ The ship that performed the first container voyage, the *Ideal X*, was not built as a pure containership but had been retrofitted for the purpose. Even the first all-containership, the *Gateway City*, capable of carrying 226 TEU (four times the capacity of the *Ideal X*) was a retrofitted wartime C-2 tanker. The *C. V. Lightning* (and three sister ships) with a capacity of 1,070 TEU and entering service in 1967, was the first fully cellular container ship, built from keel up for the purposes of transatlantic container service (Cudhay 2006:103).



Figure 19: Container ship cell guides (Creative Commons BY-SA 3.0 Seeber)

Second are the hatch covers that stretch the breadth of the cargo holds that allow for stacking containers on deck (see Figure 20). Depending on the size of the ship, containers can be stacked on deck in a cellular arrangement 13-23 abreast, 6 to 10 high, and 5-8 deep in the cargo holds.¹⁴⁶ In order to increase capacity, some vessels are designed without hatch covers; in this case, the cell guides extend as high as containers can be stacked. In addition to consisting of rows of containers, the deck includes the navigation bridge and crew accommodations, which are small due to the high automation of container ships; even the largest vessels may have a crew of less than twenty (Cudhay 2006:33, 100, 225-6; Levinson 2006:4, 55).¹⁴⁷

¹⁴⁶ Standard 45-foot containers can be stacked only above deck. Some container ships have cranes installed on deck, but to maximize capacity most ships rely on shore side cranes.

¹⁴⁷ Rolls-Royce is currently designing unmanned so-called “drone” containerhips that will be commanded from control centers on dry land. Similarly, the European Union is also funding a study called the Maritime Unmanned Navigation through Networks, which aims to develop and verify the concept of an autonomous ship (Arnsdorf 2014; see also <http://www.unmanned-ship.org/munin/>).



Figure 20: Container ship with lift off/lift on hatch covers (© TTS Group ASA)

Although some vessels still run on steam, the prime movers of container ships are diesel engines, and only the most powerful engines suffice for the world's largest container ships. That Marx mentions "ocean steamers" as part of the means of communication adequate to large-scale industry was likely because the steam engine ended the thousands year old practice of sailing ships zig-zagging ("tacking") against the wind direction (Rowland 1970; Klose 2015:92). By being able to steam in a straight line, steamships effectively turned the oceans into a system of highways for the maritime circulation of commodity capital. With steam power, ships were able to steam at 10 knots (18.5 km/h), which reduced the transatlantic voyage from more than a month taken by sailing ships to 15 days westward and 14 days eastward.

The speeds of cargo ships have increased considerably. Today container ships are capable of maintaining speeds that are very fast for sea. The average speed of breakbulk ships in the 1950s was 18 knots (33.3km/h); for breakbulk and container ships built prior to 1968 it was 20 knots (37 km/h); 25 knots (46.3 km/h) for ships entering the fleet in 1973 it was; and after 1984, the average speed of newly delivered container ships dropped to 20 knots (Broeze 2002:55-6; Cudhay 2006:149). The fastest ever container ships—Sea Land's fleet of SL-7s (2000 TEU)—were capable of speeds more than 30 knots (55km/h)

and set records for crossing both the Atlantic and the Pacific.¹⁴⁸ According to Vaclav Smil, the speed of a vessel is dependent on its size; higher speeds are a direct consequence of larger ship sizes because the larger the ship, the more time it takes to turn around in ports, which is a loss that has to be made up with high travel speeds at sea (2010:120).¹⁴⁹

While it is possible to make container ships travel faster from an engineering and technological perspective, higher speeds than 26 knots are unlikely due to the cost of fuel (Levinson 2006:249; Smil 2010:120-27). Due to their massive sizes, today's container ships have "exceptionally high power requirements" and need two-stroke diesel engines that are several floors tall to propel them (Cudhay 2006:136; Smil 2010). Acceleration at sea is, therefore, expensive because fuel consumption of large cargo vessels rises exponentially with their velocity (Meyer, Stahlbock and Voß 2012:1306). The classic example used to illustrate the cost of speed at sea is the Cunard Line's early 20th-century transatlantic steamships the *Mauretania* and *Lusitania*. To push the vessels from twenty-two to twenty-four knots, as much fuel as needed to sustain the twenty-two knots was necessary, i.e. a nine-percent acceleration required a 100 percent increase in fuel consumption (Cudhay 2006:136).

Shippers urge shipping lines to pursue speeds as fast as possible, which since the 1980s was the norm even with rising fuel prices. Since 2007, however, the practice of "slow steaming" has become standard operating procedure for shipping lines to save costs on

¹⁴⁸ The Sea-Land commerce, steaming from Yokohama to Long Beach (California) managed an average speed of 33.216 knots (61.5 km/h)—a record for the fastest ever transpacific crossing by any merchant ship (passenger or cargo) (Cudhay 2006:123-4). The trip between Oakland and Yokahama took just 5 ½ days. At 33 knots, the SL-7 was able to sail around the world in 56 days; a fleet of eight ships would provide weekly round-the-world sailing from each major port (Levinson 2006:216). In August 1972, the *Sea-Land Exchange* managed the Atlantic crossing in three days, eleven hours and twenty-four minutes at an average speed of 34.92 knots (64.6 km/h), the second fastest transatlantic voyage at the time.

¹⁴⁹ Vaclav Smil (2010:120) explains that small ships of up to 1500 TEU typically run at a speed of 15-19 knots; ships with a capacity of up to 4500 TEU run at 22 knots; ships of 5000 TEU and more run at 25 knots; and ultra-large ships (10.000 TEU<) at 26 knots. While these speeds may have been correct at the time Smil was writing, today even very large container ships typically run much slower due to the cost of fuel.

fuel (MANPrimeServ 2012:5; Meyer, Stahlbock and Voß 2012:1306). Compared to the 1990s fuel prices had increased more than 800% by 2007 (Meyer, Stahlbock and Voß 2012:1308).¹⁵⁰ Whereas full speed for a container ship is typically 24 knots (about 85-90 percent of engine capacity), 21 knots represents “slow steaming,” 18 knots “extra slow,” and 12-15 knots is considered “super slow.” While the idea of slow steaming is not new, it has never been applied to such a large part of the global container ship fleet as it is today (Meyer, Stahlbock and Voß 2012:1306). Slow steaming container ships consequently travel at speeds that are closer to the average of the 1950s and 1960s, and vessels that have adopted super-slow steaming speeds travel as slow as the 12 knots of nineteenth-century sailing clippers (Vidal 2010). Although fuel prices have recently dropped, carriers say they will continue the practice to save costs on fuel and to absorb excess fleet capacity (MANPrimeServ 2012; Knowler 2015).

Due to the long and laborious loading and unloading times, the logic of shipping during the break-bulk era was to keep ships relatively small because a smaller ship could turn around in port much quicker than a larger one. This logic changed with containerization because turning around a large container ship does not take substantially longer than a small one if several cranes can be used alongside the ship. In addition, container ships were built larger to compensate for slower speeds.¹⁵¹ Larger vessels, however, meant an improvement in the economies of scale for steamship lines that in turn led to productivity gains that drastically reduced rates for shippers.

¹⁵⁰ The 14,770 TEU containership *Emma Maersk* consumes about 16 tons of low-grade diesel bunker fuel per hour or 380 tons per day at sea. And given that fuel may exceed half of overall operating costs, shipping lines are sensitive to the price of fuel (Maloni, Paul and Gilgor 2013:153). In 2009, the price of bunker fuel was approximately \$500 per ton; at slow steaming carriers could save between 5-7 percent in costs, representing up to \$250,000 per voyage and \$15-20 million for one Asia-Europe string (Maloni, Paul and Gilgor 2013:153).

¹⁵¹ Construction cost relative to capacity is also low; for example, contrary to what one might think, building a 3000 TEU ship does not require double the steel or twice as large an engine as is used for 1500 TEU ships (Levinson 2006:234-5).

Because large ships are more economical, container ships have become larger and larger than ever, and the production of container ships have witnessed a “monstrous growth that remains nearly unchecked in the transport sector” (Klose 2015:2). As Figure 21 shows, the growth in container ship capacity has gone through six waves—each representing a new generation of container ship— starting with the retrofitted vessels of the 1950s. In 1956, the world’s first ever container ship—the *Ideal X*—had a capacity equivalent to 101.5 TEU (Cudhay 2006:27-9). The late 1960s and early 1970s witnessed a “breakneck construction of new container ships” that led to a “quantum leap in capacity” with ships breaking the 1000 TEU mark (Levinson 2006:220-1).¹⁵² In the 1970s, global container ship capacity increased by over twenty percent in a single year, four times (Levinson 2006:233). The benefits of economies of scale were so clear that in 1988 shipping lines ordered vessels that would be too wide to pass through the Panama Canal—the so-called Post-Panamax ships. While Figure 21 ends in 2103 with the massive 18,000 TEU Maersk Triple-E class vessels, as of 2016 the world’s largest container ships are Mediterranean Shipping Company’s four “Oscar class” ships that have a capacity of 19244 TEU.

¹⁵² In 1969 shipyards worldwide were busy building 199 containerships; 49 had a capacity of 1000 TEU or more (Cudhay 2006:106). That this breakneck construction occurred in the late 1960s and early 1970s is salient for the argument that the means of communication become adequate to the mode of production.

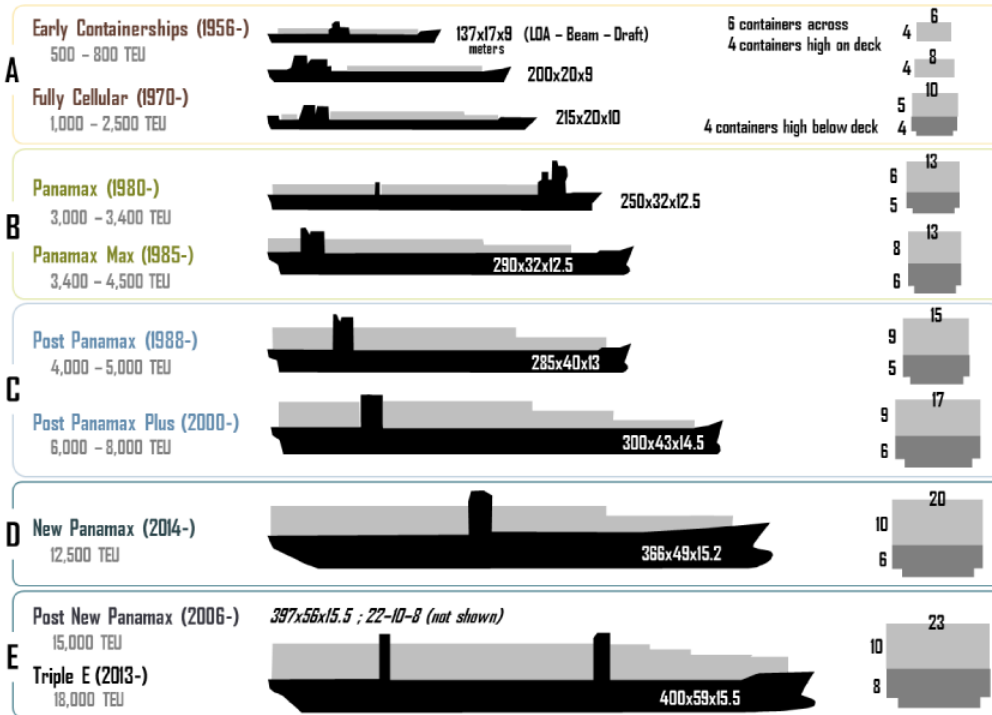


Figure 21: Growth in container ship capacity (Source: Ashar and Rodrigue 2012).

A result of this massive increase is that maritime shipping suffers from overcapacity, which means that the means of maritime communication from a capacity perspective will remain adequate to the mode of production for the foreseeable future. Nevertheless, there is seemingly no stop in the growth in capacity of international container shipping or the size of ships (Bonacich and Wilson 2008:71).¹⁵³ According to Cudhay (2006:242), the

¹⁵³ During the break bulk era excess capacity was not a significant problem because if business was unfavourable, the owner could take the ship out of service and most costs would be immediately eliminated. As I discussed in chapter three, these vessels were small and required little financing. It is the complete opposite with container ships; each of Maersk's Tripe-E class vessels costs about \$190 million. Container ships are financial assets as much as they are machinery for producing surplus-value for their owners and media for transporting the commodity capital of others (Toscano 2014). In order to pay interest and principal on the loans that financed construction and the overhead involved in renting of terminals (or debt service if the terminal is built by the shipping line), the ships usually have to keep moving even if business is bad (Levinson 2006:221-3). By November 15th, 2015, however, overcapacity had become so large that the *Journal of Commerce* could report that globally a total of 278 vessels were idle. These vessels represented 1.04 million TEU for a total of 5.3 percent of the global fleet in terms of TEU. Fifty-eight of these vessels were as large as 3-5000 TEU range (Barnard 2015). While this unused capacity is a problem for the steam ship lines, for capitals that rely on the vessels as transfer media for their commodity capital it is a benefit because maritime shipping costs remain low. It is unfortunately beyond the scope of this dissertation to consider the implications of what Innis referred to as the problem of unused capacity (1995:139-54).

limitations to vessels size come from the world's most important ports in terms of the depth and width of channels and the size of berths, which directly affect the draft, length, and beam of vessels. Some ports are simply not capable of handling large ships. But rather than setting a limit on ships, ports and canals have instead adapted to accommodate vessel operators because only the biggest ports with the highest productivity are worth time-consuming stops. Expansion of port capacity thus follows the same rationale of container ships construction because "the bigger the port, the bigger the vessels it could handle and the faster it could empty them, reload them, and send them back out to sea. Bigger ports were likely to have deeper berths. More and faster cranes, better technology to keep track of all the boxes, and better road and rail services to move freight in and out" (Levinson 2006:236). And as Figure 21 implies, with the New Panamax generation, even the Panama Canal was widened and had locks added to accommodate larger ships; in 2009 the Suez Canal was likewise deepened to prepare for larger vessels.¹⁵⁴

¹⁵⁴ The revolution in container ship capacity should be understood as a salient illustration of Marx's argument that revolutions in one branch of production have ripple effects in others.

4 Distribution Centers

The distribution center is the next logical step in the narrativization of commodity capital's movement to the market. After containers have been unloaded from ships and placed on a truck or railcar, their next most likely destination is an inland distribution center where they are unpacked, their commodity contents consolidated with other shipments, and routed on to a retail store or another distribution center. Alternatively, the commodities are stored at the facility until the time is ready to go to the market and perform exchanges. The distribution center is, therefore, an essential component in the total media system that provides logistical support to capital in the sphere of circulation.

As mentioned in the introduction to this part of the dissertation, the distribution center's status as an adequate medium to the current mode of production comes from being a building block of pull production and just-in-time retailing, and that there is currently a construction boom of these facilities in North America (Abernathy et. al. 1999:63; Bonacich and Wilson 2008:123-5; Egan 2014). More telling of its adequacy, however, is that the distribution center is a remediation of the primary function of the old warehouse. According to Fredrick Abernathy et al., the distribution center is the "anti-thesis of the warehouse" (1999:63). Whereas the warehouse was a place for storing inventory for longer periods, the distribution center operates to minimize accumulation of inventory in the facility by forwarding commodities as soon as possible on to their next destination.

As with the previous chapter on the standard container and intermodal transportation, this chapter discusses the distribution center in terms of how it materially mediates the movement of commodity capital and how it became adequate to the mode of production. With reference to Walmart, I specifically discuss the individual distribution center (1) as being part of a wider distribution network of similar facilities and retail stores; and (2) in terms of its internal operation and technological requirements for routing and/or storing the commodity capital that passes through them. First, however, it is necessary to make a value theoretical clarification with regards to what Marx refers to as commodity stock (inventory). Commodity capital's journey towards the market includes moments when it assumes the form of an idle stock in facilities like the distribution center or the old

warehouse. In order to discuss how the distribution center mediates the formal movement of capital requires a clarification about the relationship between stock, the warehouse/distribution center, and the speed and development of the means of communication and transport. I then revisit the distinction between push and pull production because the adequacy of the distribution center can best be explained with reference to how the warehouse was inadequate to pull production.¹⁵⁵

4.1 The commodity stock

In the logistics literature, the stock, or more precisely the stock-keeping unit (SKU), is the “content” of supply chains (Blanchard 2010:13). Although the primary objective of both warehouses and distribution centers is to facilitate the movement of commodities, “*as part of this movement it is often necessary to hold inventory*” in order to smooth variations in supply and demand (Rushton et. al. 2014:256, emphasis added). Marx discusses stock formation in *Capital Vol. 2* and argues that the stock is formed by commodity capital in the interval between the production process and the consumption process (1978:215).¹⁵⁶ He argues further that for commodity capital to “persist” as a stock requires that it is placed in “buildings, stores, containers, warehouses” to avoid “decay” and “the damaging influence of the elements” (Marx 1978:216). The potential damaging influences depend, however, on the “nature of the product” and therefore require more specialized “receptacles” for the stock to persist (Marx 1978:221-2). For example, perishable commodities like fresh food or flowers require receptacles that can

¹⁵⁵ Although this dissertation deals with history only secondarily and limits itself to the transition from Fordism to so-called post-Fordism, to really analyze how the means of communication become adequate and becomes a fetter before becoming adequate again, requires a much broader historical brush. In the particular case of warehousing, much could be gleaned from Braudel’s *The Wheels of Commerce* where he refers to the warehouse around the transition to capitalism as “an improved instrument of exchange” (1979:97).

¹⁵⁶ The consumption process refers both to the individual consumption of means of subsistence and the productive consumption of the means of production during the process of production. While I focus on the stock as formed by commodity capital, Marx argues that the stock actually has two additional social forms: a stock of (latent) productive capital, which is formed by the means of production bought as commodities; and the individual consumption fund, which is formed by means of subsistence bought as commodities (Marx 1978:217).

control their internal environment, such as the “reefer” container or a temperature controlled distribution center.

In chapter two, I argued that capital’s media is a broader category than Marx’s ‘means of communication and transport’ because the latter refers exclusively to capital’s transfer media. Although I discuss this broader category in detail chapter six, at this juncture it is necessary to make the following justification for why storage (or warehousing) belongs to capital’s media. That the building, stores, and containers Marx refers to are as much part of the physical conditions of circulation as the means of communication and transport can be argued with reference to how Marx conceives of the function of stock formation as necessary condition for the circulation of capital. In *Capital Vol. 2*, Marx writes that

there can be no stock without delay in the circulation sphere, without the capital persisting for a longer or shorter period in its commodity form; thus there can be no stock without a hold-up in circulation, without the commodity stock, no commodity circulation. If the capitalist does not encounter the necessity in $C'—M'$, then he encounters it in $M—C$; not for his own commodity capital, but for the commodity capital of other capitalists, who produce means of production for him (Marx 1978:223, second emphasis added).

Ignoring futures, the existence of a stock is, in other words, a condition for circulation both formally and materially. This function can best be explained with reference to how the material existence of a stock allows for multiple formal movements even if it is not physically moving.

Moveable commodity values, such as cotton or pig-iron can remain in the same warehouse while they undergo dozens of circulation processes, and are bought and resold by speculators. What actually moves here is the property title to the thing and not the thing itself (1978:226).

Here the warehouse, as the receptacle of the stock, materially mediates several circulation processes by virtue of storing the commodities and protecting them from the elements, decay, and risk of theft. In addition, the property title that serves as evidence of ownership and moves in the stead of cotton or pig-iron cannot be drawn up unless it

refers to the material existence of the stock in that warehouse.¹⁵⁷ The existence of a stock is also necessary for movable commodities. For a commodity to go to market it must depart from somewhere and, ignoring commodities that are produced to order, by a 3D printer or a future matter replicator, it must be retrieved (“picked”) from where it persists as part of a stock.

When commodities are picked from inventory, they must eventually be replenished, which leads Marx to stress emphatically that stock formation is a condition for circulation. He writes that

the stock must be constantly renewed, because it is constantly disappearing... this renewal can derive only from production... [and] depends on the periods that the commodities need for their reproduction. The stock of commodities must be adequate for this length of time... *It is only by way of this stock formation that the permanence and continuity of the circulation process is ensured*” (Marx 1978:224, emphasis added).¹⁵⁸

While this passage indicates that stocks have to be stored for relatively long periods of time, Marx argues that the level of stock holding is in part a function of the development of the means of transportation.

If transportation is cheap, fast and/or frequent, the average volume of stocks that must be kept declines (Marx 1978:220). Marx writes:

¹⁵⁷ That Marx argues that it is the property titles that move instead of the commodity emphasizes, as Reichelt articulates clearly, that Marx did not stress the autonomy of abstractions from the material realm, but rather the dependency of the former on the latter. More importantly, that the property title moves in the stead of the commodity indicates that legal documents and paperwork can be thought of as capital’s media given that their movement is how the formal movement of some commodities is materially mediated. The documents that must be signed and notarized effectively extend the cotton or pig-iron in time and space. Legal documents can be considered media of transfer for commodity capital because they facilitate the juridical transfer of private property that occurs as part of any process in which commodities change hands for money (see Marx 1976:178). An entire dissertation could likely be written on a Marxist theory of documents or the importance of documents and paperwork for the circulation of capital by drawing on the works of, among others, Bernd Frohmann (2004), Cornelia Visman (2008), Mary Poovey (2008), and Markus Krajewski (2011).

¹⁵⁸ The converse of this argument is that if commodities are not sold and “fail to make room for the incoming wave of production,” the stock expands because of a “stagnation of circulation” (Marx 1978:225).

If cotton, coal, etc. for instance took three weeks with the old means of transport to travel from their place of production or their depot to the site of capitalist *X*'s place of production, then the minimum productive stock that *X* had to hold pending the arrival of new stocks had to be sufficient for at least three weeks.... Now let improved means of transport reduce the journey to two weeks. The production stock can then be transformed from a three-week supply to one or two weeks (Marx 1978:365-6).

Although Marx is here referring to a stock of productive capital, the same applies to the stock of commodity capital. The connection between the speed of transportation and level of stock holding is important for understanding how inadequate warehouses turned into adequate distribution centers.

4.2 From the pushing warehouse to the pulling distribution center

Classically, silos—the historical antecedent to the warehouse—were used to smooth out the supply of, for example, food during winter for the individual consumption of the household or village and thus made permanent human settlements possible (Klose 2015:297). Following Lewis Mumford, Zoe Sofia argues, storage facilities proliferated “as a means to even out natural fluctuations in supplies of food” (2000:192). Commercial warehouses also even out fluctuations in supply, but for the purposes of being able to meet consumer demand at any time. With reference to the fifteenth and sixteenth centuries, Fernand Braudel argues that warehouses “were necessary because of the length of the production and trade cycle, because of the slow pace of travel and communications, the risks of distant markets, the irregularities of production and the treachery of seasons” (1979:97). In other words, the warehouse smoothed out supplies over relatively long durations, such as between harvests or long production runs. Braudel further argues that “as the speed of communications increased and the volume of transport grew, in the nineteenth century, and as soon as production became concentrated in powerful factories, the old warehousing business had to modify its ways considerably”

(1979:97).¹⁵⁹ That the distribution center is the anti-thesis of the warehouse demonstrates that this business has yet again modified its ways.

The distribution center was an invention by Walmart's founder Sam Walton, who considered goods in a warehouse a waste of money and therefore wanted facilities that were designed for rapid distribution rather than storage (Lichtenstein 2009:38). The first of the retailer's purpose built distribution centers started operating in Searcy (Arkansas) in 1978, i.e. at a time when fast, cheap, and reliable transportation was emerging. Without the means of communication and transport allowing for the commodity stock to be replenished much more quickly and according to a predictable schedule meant not only that inventory could be reduced, but made the very concept of a distribution center possible. The transformation of the warehouse into the distribution center cannot, however, be explained by improved means of transportation alone. In this part's introduction, I argued that what I termed logistical capitalism can in part be explained as a shift from a push system of (mass) production to a pull system of (flexible) production. To understand why the warehouse was inadequate to this emerging period of production and why the distribution center is adequate, it is necessary to recall a few salient points about this shift in production.

During the Fordist period, commodities had to be stored for long periods due to long production runs of masses of commodities and inaccurate forecasting. This combination led to significant inventory surpluses that manufacturers pushed upstream onto retailers who assumed the associated risk of being stuck with unsaleable commodities (Li 2007:16; Klose 2015:157). In this context, warehouses were the physical expression of the necessity of storing large quantities of commodities and acted as regulatory nodes in the distribution network by absorbing surpluses or shipping extra orders to stores during busy seasons (Abernathy et. al. 1999:63; Lichtenstein 2009:38). In short, warehouses were primarily storage facilities for receiving large and infrequent shipments of

¹⁵⁹ Braudel's argument indicates that the warehouse's transformation into the distribution center is not the first time in capital's history that this particular medium has developed to reflect a particular expression of the capitalist mode of production.

commodities that were stockpiled to smooth fluctuations in demand between long production runs (Abernathy et. al. 1999:56; Bonacich and Wilson 2008:123).¹⁶⁰

The distribution center is a product of the logistics revolution. A basic purpose of this revolution was to match supply better with demand by gaining a clearer picture of what is actually selling in order to avoid both overstocks and stock-outs. By analyzing data collected at the point of sale (POS) about what sells, retailers improved demand forecasting and started ordering products in quantities that they know will sell. Moreover, by relying on POS-data to automatically trigger replenishment orders from their suppliers, retailers improved even further in matching supply with demand. By determining replenishment orders on what occurred at the moment and place of exchange, retailers effectively pulled commodities through the supply chain and were able to lower their inventory levels in the process.

In the pull system, production is characterized by short production runs of small batches of a great variety of commodities (Harvey 1990:155-6, 177; Bonacich and Hardie 2006:169-70). Since the 1970s there has been a general increase in product variety with the result that the number of SKUs has exploded. In 2002 the US imported four times as many varieties of commodities as in 1972 (Broda and Weinstein 2004). Between 1996 and 2008, the Food Marketing Institute found that the number of SKUs had increased almost by fifty percent, up to 47,000 for a typical US supermarket (Roberts and Berg 2012:98). The number of products in the average supermarket rose from 6,000 SKUs in 1960 to 9,000 in 1974, and to between 40,000 to 61,000 SKUs in 1994 for supermarkets with eight to eleven checkout counters (Dunlop and Rivkin 1997:13). Around the turn of the millennium, the average US supermarket stocked around 50,000 SKUs, a mass retailer like Walmart around 150,000 SKUs, and a department store between 1-2 million SKUs (Abernathy et. al 1999:56; Bonacich and Hardie 2006:172; Walmart 2016b). These commodities are delivered to distribution centers and stores with more frequency than in

¹⁶⁰ For example, prior to the phenomenon of ‘fast fashion’ becoming the way to produce and sell clothes, there were primarily two seasons of selling per year, meaning that there had to be enough inventory on hand to satisfy demand for six months (Bhardwaj and Fairhurst 2010:167).

the push system. Retailers typically get shipments based on ongoing weekly or bi-weekly orders of what sells, although Walmart restocks their stores twice per week (Haiven and Stoneman 2009:12).¹⁶¹ While this frequency reflects how commodities are produced in short runs of small batches, it is also a strategy for improving forecasting because more frequent replenishment shortens the time window for which demand has to be predicted.

In the pull or just-in-time system of production and distribution, there is a consensus that the volume of stock should be minimized. The collection of inventory is a “balancing mechanism of last resort” and is held, if at all, at a few strategic locations (Baker 2004:112). Retailers are consequently more likely to keep purchasing commodities with high velocities and which do not need to be stored. The goal of these facilities is to have commodities “arrive and depart on a just-in-time (JIT) or as-needed basis” (Bonacich and Wilson 2008:123; Baker 2004). The distribution center is the material incarnation of this goal and is the antithesis of the warehouse. Due to product proliferation, the increased number of shipments, and POS-data triggering replenishment, distribution centers have “to be more flexible and agile than a simple storage facility” (Bonacich and Wilson 2008:125).

The distribution center must process incoming commodities quickly and efficiently, match them to purchase orders, and re-route them for shipment to the right store or another node in the distribution network. In the context of the logistics revolution and global supply chains, distribution centers thus serve as the “nexus between retailers and their suppliers” (Abernathy et. al. 1999:63) and therefore also as “mediators between the global system of harbors and ships and the regional system of trains and trucks” (Scharmen 2006:n.p.). Alternatively, to borrow Jesse Lecavalier’s (2010) metaphor, distribution centers are “valves” that regulate the flow of commodities in the sense of controlling how much comes out, how fast, at what time and the direction of this flow. In other words, distribution centers are where the state of the supply chain’s inventory is

¹⁶¹ Walmart completely restocks its stores the equivalent of once per 40 days (Haiven and Stoneman 2009:12).

assessed or, as Bonacich and Wilson argue, it is “the central location where ‘pull’ production is made to function” (2008:123).

That the distribution center is a remediation of the warehouse means, however, that the former has retained some of the basic functions of the latter; they still receive commodities from suppliers, store them until required, and, after they are picked from inventory, ship them to the next or final node in the supply chain (Baker 2004). What has changed, however, is the temporality of the warehouse; both incoming and outgoing shipments are more frequent, and commodities may persist as a stock in the facility for such a short time that describing it as storage would be incorrect. The change in focus from storage to routing or forwarding has naturally led to a change in the physical design of the old warehouse facility. I now turn to a discussion of the distribution center as a media system, focusing both on its internal design and its external network.

4.3 The distribution center media system and merchant’s capital

Distribution centers cannot be analyzed as singular units, but must be understood as nodes in a larger network of such centers and retail stores. The location of a particular distribution center is dependent on where other distribution centers are located, the retail stores it will serve, and proximity to infrastructures like highways, railways, and ports. As the reference to terminals and domestic suppliers suggests, not all distribution centers are alike, but will have specific roles in the overall distribution network, which also determine their locations. For example, a facility located close to a maritime container port will serve to forward incoming imports to other distribution centers rather than retail stores. There is, therefore, a typology of distribution centers based on their purpose in the supply chain.¹⁶² The function of distribution centers also determines the technology they

¹⁶² The logistics literature uses the following categories: consolidation centers for bringing different commodities together to be delivered together as one single order to the customer; cross-dock centers where commodities are directly transferred from the incoming to the outgoing vehicle; sortation centers where commodities are sorted according to specific region, postal code, or customer; assembly or postponement facilities where the commodity assumes its final form as per customer customization; storage facilities; and returned goods centers (Rushton et. al. 2014:257-8). The name of a distribution center is

require to operate internally and how they interface with other media externally. An import distribution center will have technology that allows it to handle incoming containers, while a facility for handling perishable groceries will be temperature controlled. The distribution center as a media system consists of the stationary infrastructure of the building, its internal technology, the trucks that deliver and receive cargo, and transportation infrastructure like highways.

The following discussion of distribution centers as a network and their internal operations are primarily based on Walmart. Because their distribution center and pioneering logistics activities have been copied by other retailers and third party logistics providers, I treat the particular facilities and network of Walmart as representative of all such media systems for processing and storing commodity capital.¹⁶³ A conceptual problem of focusing on Walmart, however, is that it appears as if I am treating the particular conditions of a company's business operations as a medium for capital even though I argued in chapter two that the media phenomenon belongs to the general conditions of production.

Walmart, however, remains relevant here as an example of merchant's capital, which is a type of capital that "functions exclusively in the circulation process" (Marx 1981:380).

Merchant's capital can be contrasted with industrial capital on the basis of what form of capital they primarily deal in; whereas the latter is concerned with production and deals in productive capital, the former is concerned with buying and selling (i.e. circulation)

usually based on the role it serves. Hence, it can be called a warehouse, cross-docking center, sortation center, returned goods center etc. (Rushton et. al. 2014:258). Confusingly, companies refer to their distribution centers according to their own typology. For example, Walmart calls their consolidation distribution centers "center points," while Target calls them "domestic consolidation points" (Wulfraat 2016a; 2016b).

¹⁶³ The proliferation of Walmart's logistics innovations is partly due to these being taught as curriculum at business schools worldwide. These innovations include the strategy of expanding around distribution centers, using EDI with suppliers, and the concept of the big box store format (Hugos 2003). Many other so-called "big box" retailers (e.g. Target and Best Buy) run similar supply chain operations to that of Walmart (Lichtenstein 2009:6). In this chapter, I therefore make reference to Target due this company having modelled their operations on Walmart.

and therefore deals in commodity capital (Marx 1981:379-81).¹⁶⁴ It is the position of retailers and wholesalers in the overall social process of production that justifies why Walmart's distribution network and facilities belong to the general conditions of production. First, because Walmart does not produce anything their facilities cannot be particular conditions of production.¹⁶⁵ Second, Marx considers circulation (exchange, buying, and selling) to be part of the general conditions of production because it benefits all capital and not just one. In *Capital Vol. 3*, Marx argues that merchant's capital, by taking on buying and selling as an exclusive function, not only facilitates but also accelerates the circulation of commodities for many industrial capitals (1981:381). Given this functioning of merchant's capital within and for the circulation process, I argue that this type of capital belong to the general conditions. It follows that Walmart's distribution centers also belong to the general conditions because the ability of the company to carry out the functions of buying and selling is dependent on these facilities.

4.3.1 Distribution center networks

The core of Walmart's logistics and the backbone of their retail empire is their distribution network, which within the US as of 2016 comprised 152 distribution centers supporting over 5,200 retail stores (Walmart n.d.; 2016a; Wulfraat 2016b). This distribution network also includes 6,100 trucks, 61,000 trailers, and close to 8,000 drivers. To support their distribution strategy of reducing inventory levels and avoiding stock-outs, Walmart operates with different supply chains for separate categories of commodities, like general (hard) merchandise, perishables, and specialty categories like fashion and footwear. This "service level segmentation" means that Walmart's distribution centers can be subdivided into what commodities they process and the stores

¹⁶⁴ The circuits of industrial capital and merchant's capital are different. Whereas the former's circuit is the one I have discussed in this dissertation as *the* circuit of capital and with the formula $M-C\dots P\dots C'-M'$, the circuit of merchant's capital is identical with the sphere of circulation and its formula is $M-C-M'$.

¹⁶⁵ I am here ignoring that transportation and logistics are also branches of production that do create value. Walmart's logistics is, however, not concerned with producing a logistical commodity to sell to others, but with contributing towards maintaining their "everyday low prices."

or other distribution centers they serve. Following Marc Wulfraat's analysis, Walmart's distribution center typology is as follows: regional general merchandise; grocery and perishables; import (located close to US maritime ports and the Chicago rail yard); Sam's Club; specialty (e.g. optical labs, pharmaceuticals, tires, print and mail, e-commerce, and returns); and center point (for consolidating shipments from domestic suppliers) (Walmart n.d.; Wulfraat 2016b).¹⁶⁶

I pay particular attention to Walmart's regional general merchandise distribution centers (RGMDCs), which currently number at forty-two and were built to distribute so-called "hard lines" of commodities, which primarily refer to non-food products including toys, electronics, health and beauty aids, appliances, sports goods, and so on. Since 2006, however, these distribution centers also distribute 4000 of the fastest moving dry grocery commodities. In general, Walmart positions commodities with high velocities as close as possible to their markets, leaving slower moving commodities at fewer distribution centers and further away from stores (Wulfraat 2016b). This positioning of commodities is therefore connected to where the distribution centers are located.

Walmart's operations are "fundamentally concerned with territory" and they conquer markets using RGMDCs as beachheads (Lecavalier 2010). The locations of both distribution centers and stores are decided based on a calculation of miles and minutes in order to optimize the movement of their commodity capital and cut the costs of their trucking operation. As Figure 22 shows, the RGMDCs are located at strategic points in the US highway system; other distribution centers are located next to other transportation infrastructure, such as maritime and inland container terminals. When Walmart expands

¹⁶⁶ This segmented distribution center network processes supplies from over 9000 direct suppliers (and their subcontractors) domestically and internationally, although 80 percent are located in China (Haiven and Stoneman 2009:3-4). Walmart is the single largest importer to the US with twice the number of TEUs as the next largest importer (Target); containers destined for Walmart arrive to a North American port on average every 45 seconds ((Bonacich and Hardie 2006; Klose 2015:156). In 2015, approximately 81% of the commodities sold in Walmart stores were moved through the retailer's distribution center network. The remaining commodities—primarily food and beverages—are delivered directly to stores (so-called direct store delivery or DSD) by suppliers bypassing Walmart's distribution network (Wulfraat 2016b). Walmart has an additional nine disaster distribution centers, strategically located in the US to provide rapid response to communities in the event of natural disasters.

into a new geographical area, they first build an RGMDC in a central location around which they open a group of stores. RGMDCs support between 90-170 stores within a 200-mile radius (see Figure 22) with the average one-way distance to a store being approximately 124 miles (Lichtenstein 2009:39; Walmart n.d.).

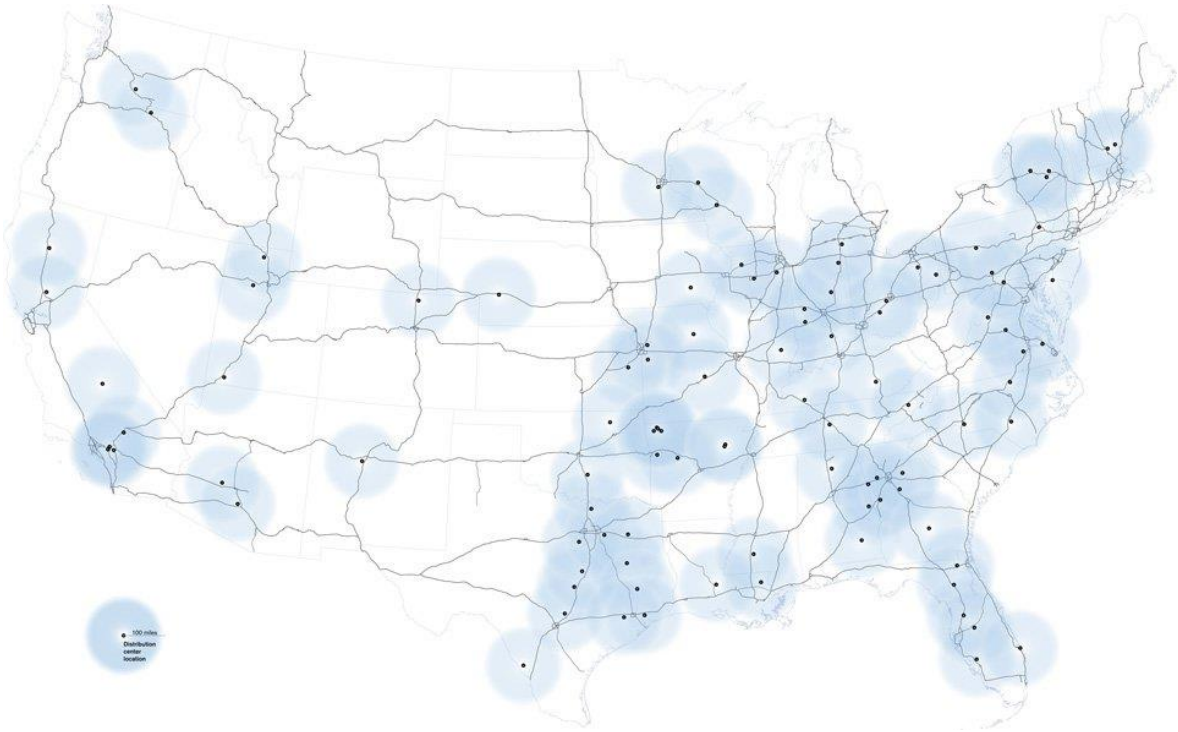


Figure 22: Map of U.S. Interstate Highways and Walmart distribution centers (Source: Lecavalier 2010).

This strategy of “geographic fortification” enables the retailer to add stores at little extra cost because the distribution network is already in place. If a particular part of this network reaches capacity, Walmart builds a new regional distribution center to relieve the pressure and prepare the given geographical area for even more stores (Lecavalier 2010). The retailer effectively saturates a geographic area with stores before moving on to another area; while this strategy leads to one store cannibalizing the sales of others, it ensures maximum regional sales (Hoopes 2006:92; Lecavalier 2010). Due to Walmart’s geographic fortification, 60 percent of the US population lives within 5 miles of one of

their stores and 96 percent live within 20 miles (Zook and Graham 2006:20).¹⁶⁷ As Figure 23 shows, Walmart has blanket coverage of the majority of continental United States.

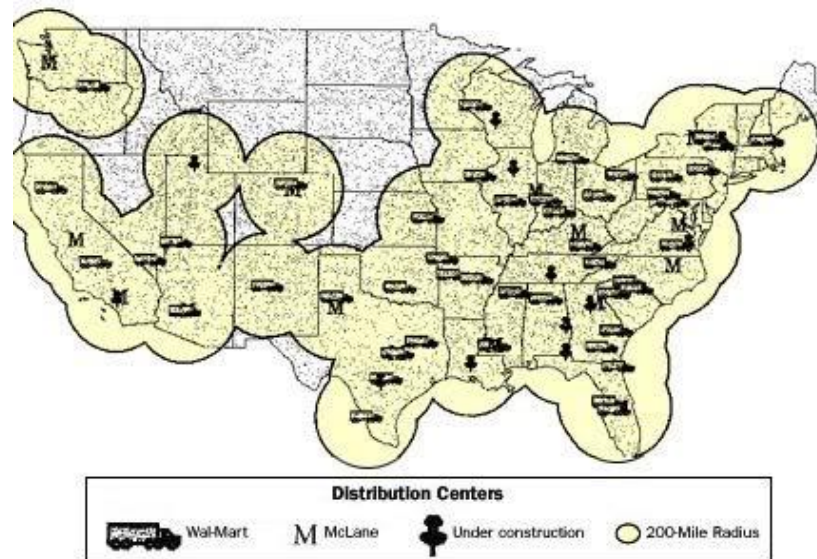


Figure 23: Walmart's conquest of geographical areas with distribution centers (Source: Teamsters 2000)

4.3.2 The internal operation of distribution centers

There are broadly two types of flow through a distribution center; this flow is determined by the relative velocities of commodities. Commodities that remain in a distribution center for days and weeks refer to a flow of commodities that correspond to the classical storage of warehouse, while commodities that move through the facility in minutes and hours refer to a flow of commodities that correspond to immediate forwarding. In the former case, the commodity stock is then a mere condition of circulation until it is

¹⁶⁷ Walmart thrives in rural, semi-rural and, suburban areas, but have had difficulties in establishing themselves in urban areas. Within the limits of New York, Los Angeles, and Chicago — the country's three largest cities — residents will find only two Walmart Superstores. An assumption Walmart makes is that their customers will be motorists (Haiven and Stoneman 2009:3; Lecavalier 2010).

retrieved from its assigned pick location, whereas the circulation process is uninterrupted in the latter case. The technological requirements of a distribution center broadly reflect these two types of flow. Although the general aim of distribution centers is to minimize the percentage of commodities that are stored and maximize the proportion of those that pass through, particular distribution centers in the network have to have enough space and necessary technology to store commodities with low velocities and dispatch them when they are in demand (Klose 2015:159).

The majority of commodities passing through distribution centers are in general of higher velocities and therefore remain in the facility for a short time.¹⁶⁸ The practice that best corresponds to the operation and role of the distribution center is the Walmart invention of “cross-docking”; prior to or upon a delivery truck’s arrival, commodities will already have been allocated to specific stores. At the facility, the truckloads are unloaded, broken down into smaller lots, rapidly moved to an outbound truck for consolidation with other commodities bound for the same destination (Baker 2004:113-4; Bonacich and Hardie 2006:172). While cross-docking is still an ideal and commodities are still stored in warehouses, they are increasingly being “reoriented toward perfecting a constant-flow model” (Bonacich and Wilson 2008:123). Cross-docking has therefore had a profound impact on the design of warehouses and is arguably a phenomenon that contributed the most to the transformation of the warehouse into a distribution center. It is, therefore, important to consider how these particular facilities are designed.

Warehouses used to be large, multi-story buildings with low ceilings and shelving for storage, but today they are single-story facilities with high ceilings. From the outside there is nothing remarkable about an RGMDC facility; from a bird’s eye view, it looks

¹⁶⁸ When Abernathy et. al. were writing, approximately 30 percent of commodities in a major distribution center of a big retailer remained at the distribution center for sorting and storage (1999:65). In Walmart’s distribution centers, the percentage is lower; for example, distribution center 6094 outside of Bentonville turns over 90 percent of its contents every day (Lecavalier 2010). Commodities have different velocities; for example, groceries in general sell fast, while high-value items like jewelry are slow. In general, however, “most products sell at a slow rate”; a study of thirty-two US retailers found that an average stock keeping unit (SKU) sold about a unit per month per store (Fisher and Raman 2010:5).

like two enormous rectangular boxes arranged diagonally, with one being narrower than the other (see Figure 24). A Walmart RGMDC averages between 1 and 1.6 million square feet and has a stacking height of 35 feet. From street view, it looks like a non-descript industrial facility but for the hundreds of rectangular holes on opposing sides. As depicted in Figure 25, these holes are the docks for the unloading and loading of trucks, where at any time a number of trucks will be positioned; on average a Walmart distribution center turns around over 200 trucks per day (Walmart n.d.; Walmart 2016a; Bonacich and Wilson 2008:129; Lichtenstein 2009:39; Klose 2015:155-7; Wulfraat 2016b).



Figure 24: Walmart regional general merchandise distribution center (Source: Wulfraat 2016b)



Figure 25: Walmart distribution center truck docks (©Blue Scope Construction)

4.3.2.1 Storage

Both high and lower velocity commodities pass through an RGMDC. The larger part of the facility is a racked section for storage of palletized commodities and receives all commodities that are not cross-docked. This section of the facility is equipped with technology for storage and retrieval. While this technology may be as simple as racked shelving for pallets in combination with forklifts in some warehouses, a Walmart distribution center is highly automated and relies on sophisticated automated storage and retrieval systems (ASAR). Commodities destined for storage are placed in an assigned “pick location” in the storage racks by the ASAR system, which moves pallets on conveyors and lifts (see Figure 26).¹⁶⁹ The storage racks are high-density and thus designed to maximize the storage space of the section. For example, the main complex of Target’s regional distribution center, for example, is fitted with a high-rise and high-density ASAR system for storage of over 300,000 pallets. When an order comes in for any of the stored commodities, they are picked from their assigned locations in the storage racks as entire pallets or individual boxes using electric double pallet jacks or ASAR picking conveyors that run three to four levels high and rely on scanning barcodes for identifying and retrieving the correct package (Lecavalier 2010; Wulfraat 2016a; 2016b).

¹⁶⁹ Commodities with higher velocities relative to the other stored commodities are placed in locations close to where orders are consolidated.



Figure 26: Example of pallet high rise racking automated storage and retrieval system (© Dexion China)

4.3.2.2 Routing and forwarding

The narrow section of the RGDMC (Figure 24) is designed for cross-docking of individual boxes and full pallets of commodities with high velocities, and contains a sophisticated conveyor system between 10-20 miles in length for speedy material handling (Walmart n.d.; Wulfraat 2016b). As Klose argues, a cross-docking facility is “organized like a gigantic computer whose processing units are boxes” (2015:159). Boxes, packages, and pallets are the inputs and outputs of the system; more specifically the outputs are commodity capital with a new address. In addition to the truck docks that can be understood as interfaces, this computer consists of “an automated, fast-moving conveyor network connecting them, and a sophisticated information system to control movement from receiving to shipping docks as well as process the transactions relating to those systems” (Abernathy et. al. 1999:63).

The conveyors consist of automated belts that connect incoming docks to outgoing ones and other areas (see Figure 27). They are equipped with actuators, sensors, and switches—controlled by microprocessors and the distribution center’s internal computer system—for the identification, control, and routing of individual boxes to the correct

dock or designated area for additional handling (Abernathy et. al. 1999:66-7; Lecavalier 2010).¹⁷⁰ From the receiving docks, the conveyed boxes first converge at a “merge” center for sorting, which occurs automatically when the conveyor system scans the boxes’ labels with its sensors and uses its “arms” to guide them physically into one of the chutes that lead to a shipping dock and waiting truck (Lichtenstein 2009:39).



Figure 27: Walmart conveyor system (© Walmart)

The design of the conveyor system is based on graph theory in order to minimize the number of paths packages can travel and maximize the number of boxes conveyed (Klose 2015:160). The conveyor system can move boxes at a rate of about 200 feet per minute and process 120 boxes per minute for a daily total of hundreds of thousands (Walmart n.d.; Abernathy et. al. 1999:67; Lichtenstein 2009:38). Already in 1999 Abernathy et. al. could write that these “conveyor technologies have reached the point where the limiting factor on physical conveyance is the time it takes to load a truck” (1999:67). The only

¹⁷⁰ This additional handling includes making commodities store-ready by putting them on displays or hangers in the case of apparel; customization of commodities, such as adding extra memory to a laptop; or inspecting boxes that have produced errors when scanned.

part of this operation that is not automated is the unloading and loading of trucks, which require around 600 workers.

The rapid and automatic routing of boxes or their automated storage and retrieval require technology that can efficiently and accurately identify boxes. This identification is provided by the barcode and the Universal Product Code (UPC), and complementary scanning hardware and software. Walmart's suppliers are required to apply compliant labels with barcodes (see Figure 28) to boxes, pallets, and other types of packaging accepted by the retailer. The first step of the unloading procedure in general, but in particular with cross-docking, is to position boxes, packages, and pallets so that their barcodes can be read immediately by scanners at the docks (in this step, information about the products and quantity is checked against orders and their final destinations), and subsequently by the conveyor system thus allowing for their tracking and forwarding through both the distribution center and the supply chain (Abernathy et. al. 1999:65-6; Lichtenstein 2009:39).



Figure 28: Walmart compliant label with barcode (© T.L. Ashford)

While the barcode was originally invented by the grocery industry to revolutionize their checkout process, general merchandisers like Kmart and Walmart adopted it primarily to

manage their inventory and increasing number of SKUs.¹⁷¹ The barcode replaced documents and paperwork as the method for identifying and tracking inventory and allowed for identifying commodities down to the individual SKU level. The technology and standards underlying the barcode are therefore fundamental to the pull system of production and distribution (Abernathy et. al. 1999:57, 61; Bonacich and Hardie 2006:170).

Martin Christopher (2011) observes that although information has always been central to efficient logistics, today, “enabled by technology, it is providing the driving force for competitive logistics strategy” (2011:146). A key feature of global supply chains and their management is, therefore, the information system, which goes beyond just planning and control, towards enabling “time and space to be collapsed through the ability to link the customer directly to the supplier and for the supplier to react, sometimes in real time, to changes in the market” (Christopher 2011:144). On the role of information, Yves de la Haye argues that it is “what the lubricant is to the machine: circulating within it, it irrigates all the points of friction so as to limit overheating and eliminate cracking” (1979:29).

Walmart is a case in point; it collects troves of data from over 140,000 POS-systems worldwide and continually tracks the movement of their stock—consisting of 680 million distinct commodities—through the supply chain (Haiven and Stoneman 2009:11). Christopher argues that global logistics is really about the management of information flows (2011:184). The commodity is doubled, not in the Hegelian sense of splitting into a new category, but into the information of SKUs/UPCs as a record of the commodity.¹⁷²

¹⁷¹ I discuss the barcode and the UPC in more technical detail in the next chapter and in relation to the point of sale.

¹⁷² As Klose points out, this doubling is not exclusive to the capitalist mode of production, but is “true for every historical system of inventory and accounting” (Klose 2015:235). While both the SKU and the UPC are numeric-based codes assigned to commodities, they are not identical. The latter is a universal standard that is affixed to a commodity as a barcode wherever it is sold, and can be scanned and decoded by anyone with the right hardware and software. The SKU, however, is unique to the company; a commodity with the same UPC in two different stores would have different SKUs.

The circulation of commodities is thus “doubled by flows of information, by a signifying chain that superintends the commodity chain, sometimes without human intervention at all” (Bernes 2013:n.p.). As Jesse Cavalier argues, the UPC and the SKU importantly “serves in a sense to abstract the items moving through Walmart’s supply circuits; they are registered and tracked as numbers rather than things” (2010:n.p.). While it is commodities in boxes, packages, and pallets that move through a supply chain, they are managed as information, specifically as stock-keeping units (SKUs), which are therefore as much the content of supply chains as the natural forms of commodities.¹⁷³

The informatic doubling of the commodity via the barcode also enabled connection between the front- and back-ends of retailing. While I discuss the collection and use of POS-data in the next chapter, for now, it is sufficient to know that it is information collected at and about the moment of exchange that tells distribution centers what commodities should go where, at what time, and in what quantity. A complementary technology to the barcode is, therefore, EDI, which facilitates rapid transmission of large quantities of information with greater accuracy than paper-based transactions. Without a standard like EDI, the information sent may be unreadable or require extensive translation (Abernathy et. al. 1999:62). Through EDI retailers gain “control over the scheduling and receiving of products, ensuring a steady flow of products to its stores” (Bonacich and Hardie 2006:171). More broadly, the “muscle and bone” of distribution centers require a “nervous system” of ICTs (Lichtenstein 2009:40). A single distribution center on its own requires enough processing power and storage capacity to handle hundreds of thousands of transactions associated with ingoing and outgoing shipments, such as matching incoming barcode data with purchase orders. The computer system, therefore, requires considerable processing power, storage capabilities, and sufficient bandwidth to transmit and receive information (Abernathy et. al. 1999:67).

¹⁷³ Interestingly, Sam Walton argued that “[p]eople think we got big by putting big stores in small towns. Really we got big by replacing inventory with information” (Roberts and Berg 2012:144).

To operate efficiently, distribution centers also require a set of standardized practices between suppliers. In addition to applying barcodes and other compliant labels, Walmart has standardized the physical aspects of shipping to make the movement of boxes through the distribution center as efficient as possible, for too much variation may reduce the number of packages that move completely automated through the distribution center. This standardization includes the size, shape, and weight of boxes, the exact spot for placing labels, and even how boxes should be packed (Abernathy et. al. 1999:67-8; Bonacich and Hardie 2006:173). Also, suppliers must be in strict compliance with the delivery window of distribution centers, which in the case of Walmart's cross-docking operations is around fifteen minutes (Petrovich and Hamilton 2006:133). By having fast and efficient distribution centers and forcing standardized practices onto suppliers, individual retail stores become strictly devoted to making commodities perform exchanges. Whereas it used to take days before incoming shipments were placed on the retail floor due to the necessity of taking inventory and making them display ready, today it takes just a few hours because these activities now occur at a distribution center or at the source (Abernathy et. al. 1999:68).

4.3.3 Distribution center variations

Considering that Walmart and other retailers and logistics companies typically follow a strategy of service-level segmentation and therefore have distribution centers built for a specific role in the distribution network and/or for the particular commodities they process, there are some salient differences in design and technology in these other distribution centers from that of the RGMDCs. Of particular note are grocery, import, and consolidation distribution centers.

Grocery distribution centers are notable because they are designed to process perishable as well as dry groceries. Walmart's 43 grocery distribution centers serve a slightly smaller number of stores than the regional distribution centers and have an average 134 miles one-way distance to the stores they serve. These facilities are typically L-shaped, with a square dry grocery complex with docks on three sides and a long rectangular perishables building with ingoing and outgoing docks on both sides. To handle frozen food, fresh meat, and produce, the facilities are, like refrigerated containers, temperature

controlled environments from 0°C to -26°C. Target's perishables distribution centers rely on voice picking technology for speedy and accurate retrieval of commodities, as well as an ASAR system to automatically store incoming pallets and replenish picking locations at multiple levels (Wulfraat 2016b).

Import distribution centers are giant structures for receiving imported containerized cargo. Walmart has eight headed for regional or grocery distribution centers rather than individual stores. A single state-of-the-art import distribution center can handle up to seventy thousand containers and pallets daily, and can load and unload fifty to seventy trucks at the same time (Bonacich and Wilson 2008:126). Both Target and Walmart's import distribution centers serve as more classical warehouses in which inventory is held as a buffer until needed by other distribution centers. These distribution centers are consequently equipped with multi-level ASAR systems (Wulfraat 2016a; 2016b). To process cargo coming in less-than-truckload (LTL) from domestic suppliers, both Walmart and Target have narrow, rectangular cross-docking distribution centers that consolidate cargo into full truckloads (FTL) dispatched to regional distribution centers or individual stores (Wulfraat 2016a; 2016b).

So far we have examined how commodity capital moves towards the market after it has entered North America in containers and been rerouted to distribution centers from where this capital is sent on to its final destination in a retail store. In the next chapter, we look at the commodity's sale and conversion into money at the point of sale, and how data about what occurs at this point is recorded and mined in order to improve inventory management and the movement of capital through the supply chain.

5 Point-of-Sale and Payment Systems

The terminal point of a supply chain is the market where commodities perform exchanges and turn into money. As with the other points in the supply chain, specific media systems facilitate this final movement of commodity capital. There are two things that set media systems at the point of exchange apart from those I discussed in chapters three and four: (1) they materially mediate how commodities “perform exchanges” rather than how they “go to market”; it then follows that (2) these systems do not have a liminal existence in the spheres of both production and circulation but are instead “pure” media that are designed for the exclusive purpose of positing value in its form. Payment systems like VISA, Mastercard, and Interac are in a special category because they materially mediate the movement of money rather than commodity capital. In this chapter, I, therefore, turn to (1) point-of-sale (POS) systems and how they record data about the moment of exchange by scanning barcodes; (2) POS-data and its uses; and (3) payment systems and how they process payments with specific reference to VISA.

5.1 POS-systems

For nearly a century after its invention in 1879, the mechanical cash register was typically the only technology a consumer would encounter at the POS because management viewed collecting cash as almost the exclusive focus of the POS. In the 1970s, however, this focus shifted toward also collecting data (Cortada 2004:295). This shift in focus can be understood as a reflection of POS media becoming adequate to the logistical capitalism’s need for information to better match supply with demand. By the early 1970s, the mechanical cash register was becoming obsolete precisely because it was not adequate in terms of its data collection capacities when compared to the new and emerging ICT at the time (Brown 1997:69).¹⁷⁴ While a cash register is an integral component, a POS-system is, in essence, a data collection system that is designed for the

¹⁷⁴ While some retailers began to address the problem of data collection at the POS with computers as early as the mid-1950s, most retailers’ interest in electronic POS technology dates from the 1970s (Cortada 2004:289).

retail trade. The main objective of implementing ICTs at the POS was to integrate a system for reliable tagging and automatic identification of products with POS recording devices such as electronic cash registers, automatic price scanners, and credit card readers (Cortada 2004: 294-5; Petrovich and Hamilton 2006:116). The operation of POS-systems is thus concerned with two things: the collection of POS-data and of payments.

POS or retail management systems are computerized networks operated by a central computer and linked to several checkout or POS terminals. These systems are a direct remediation of the mechanical and electronic cash register. All POS-systems are a combination of hardware and software, although their specific configuration depends on the particular requirements of the retailer and what they are selling. There are therefore particular POS-systems for general merchandisers, restaurants, dry cleaners, and so on. At its core, the POS-terminal is a computer that comes with customized software and peripheral devices specific to the particular retail environment. As Figure 29 shows, these peripheral devices include a cash drawer, a (touchscreen) monitor for the checkout worker, a display monitor for the customer, a printer for receipts, barcode scanners, weighing scales, and a payment terminal with PIN and/or signature capture for payments made with debit, credit, or other types of payment cards. The POS terminal and peripherals can be mounted on a checkout counter with conveyor belts (see Figure 30) (Khurana 2010).



Figure 29: POS-system with peripherals (© Tigerbyte)



Figure 30: Checkout counter with conveyor belt (© Abdin)

Being a computer, the POS-system can perform more complex operations than that of the mechanical and electronic cash register it replaced. While the POS-system's software was initially about processing sales, it has today expanded to include a number of other applications for the back-end of retailing, including applications for handling gift cards and registries; recording and tracking customer orders; returns and exchanges; producing reports on daily sales and sales trends; customer relations management (e.g. collecting Zip codes and emails, processing coupons, and signing customers up for loyalty cards); barcode label creation; accounting; and a variety of other applications. Vivally, because the POS software records every individual sale, POS-systems are integral in managing inventory levels and therefore in making decisions about what and when to order something (Khurana 2010). The capability to record data about transactions down to the individual SKU, however, comes from the barcode and thus the peripheral device of the barcode scanner.

5.1.1 The barcode and the Universal Product Code

The first success in integrating automatic identification of products with POS hardware came in the early 1970s with the grocery sector's development of the inter-industry Universal Product Code (UPC) and its machine-readable representation in the barcode (Dunlop and Rivkin 1997:2; Cortada 2004:296). The original impetus for developing a

machine-readable product code was not at first for the purposes of data collection, but to automate the checkout process in supermarkets. Even with electronic cash registers, checkout workers took a long time to enter the price of every single commodity passing through their counters. At the time, the only way to increase circulation at checkout was to add and/or use additional checkout counters and workers. Not only did this mean that labour costs in the US grocery industry were high, but also that the time customers spent waiting to pay was long. While retailers, in general, want customers to stay in a store for as long as possible because it stimulates sales, they seek to minimize the time customers wait in line because the longer they wait, the more likely the customer will leave or rationally think about what they are buying (Underhill 1999). By automating the POS and accelerating the checkout process, grocery retailers could achieve two things: eliminate labour at the checkout counter and avoid the risk of losing sales due to long lines (Brown 1997:xv).

The UPC is a code numbering system that consists of 12 numeric characters with each digit having a specific meaning. As Figure 31 shows, the UPC starts with a single number system character that introduces the six-number company prefix (or manufacturer's number) and ends with a check digit. The five numbers between the prefix and the check digit are the reference numbers that a manufacturer assigns to their unique commodities.¹⁷⁵ The check digit verifies that the barcode is correctly composed and is mathematically calculated with an algorithm based on the first 11 digits (Dunlop and Rivkin 1997:3; Brown 1997:281; Simply Barcodes n.d.). Each UPC number is a unique code that can be associated with a particular manufacturer and commodity. They are assigned to companies and managed by the organization GS1 (previously the Uniform Code Council), which also gives manufacturers a unique and permanent designation for the first set of digits (Dunlop and Rivkin 1997:3; Brown 1997:94).¹⁷⁶

¹⁷⁵ The number system character indicates the number system to be used by the remaining digits. For example, if the number system character is a "2", the rest of the UPC refers to drugs by their national drug code number.

¹⁷⁶ UPC codes can be obtained by being leased directly from the GS1 for an initial and ongoing annual fee or purchased from third party companies that have leased barcodes from the GS1. After GS1 began issuing



Figure 31: Barcode (© Computalabel International)

Whereas the UPC is the standard method for identifying products, the barcode enabled the automatic identification. A barcode is a standardized, optical machine-readable representation of data about the object it is attached to, although it was originally developed to be a symbolic representation and machine-readable version of the UPC.¹⁷⁷ The symbol was developed to be an omnidirectional binary symbol with an accuracy of scanning of over 99.99 percent; it can be magnified or reduced from the nominal size to fit different types of packaging without increasing the risk of errors in scanning (Brown 1997:281-3). Because the barcode was developed by the grocery sector, it was also designed to be readable in the worst of environmental conditions found in supermarkets; it can be scanned through ice, stains, heat moisture, and so on. The symbol was also

7-, 8- and 9-digit manufacturer's prefixes, it is currently not possible to examine a given UPC and determine what portion is the fixed manufacturer number and which one is a product number (Simply Barcodes n.d.). The length of the company prefix relative to the standard 12 digits of the UPC system limits the number of possible unique barcodes. With a six-digit company prefix, 100,000 unique barcodes can be made; with a seven-digit prefix, 10,000 barcodes can be made; with an eight-digit prefix, 1,000 barcodes can be made; and so on.

¹⁷⁷ The barcode systematically represents data by the variation in width and spacing of one-dimensional parallel lines. As Figure 31 shows, it consists of a series of 29 light space and 30 dark bars in varying widths and in parallel, and with a human-readable numeric font equivalent below. Each character or digit of the UPC is represented by 2 dark bars or 2 light spaces, respectively representing binary code's 1 and 0.

developed to bypass traditional price labeling and consequently had to be tamper-proof to prevent making it so that products appeared lower priced (Brown 1997:58, 65).¹⁷⁸ On the basis of the recommendations of the Uniform Code Council (UCC) and the Voluntary Interindustry Communications Standards (VICS), and subsequently *de facto* through use, the UPC, and the barcode became the standard for POS-scanning devices in the late 1980s (Brown 1997; Abernathy et. al. 1999:61).

The barcode proved to be the “most significant productivity improvement in the (grocery) industry since the introduction of the supermarket” (Brown 1997:xi). It increased the productivity of checkout workers considerably; automated checkout counters operated 50-75% faster than conventional hand checkout, allowed for instant price changes, had close to no checking errors, reduced lines at the checkout, and made compiling end-of-day summaries much faster (Brown 1997; Abernathy et. al. 1999:60; Cortada 2004:328; Lichtenstein 2009:41).¹⁷⁹ By automating record keeping tasks, the barcode also reduced the cost of and helped avoid paralysis in managing the proliferation of products that hit the market in the 1970s. The benefit to manufacturers was that they gained better information on sales and reduced stock-outs (Brown 1997:125-6; Lichtenstein 2009:42).

¹⁷⁸ The development of the barcode was shaped by other technological developments in the late 1960s and early 1970s. Innovations particularly in optics and laser technology, as well the integrated circuit essential for rapid computation were critical in making barcode scanning both feasible and economical; just a decade earlier an automated checkout counter would have been both expensive and likely technically impossible (Dunlop and Rivkin 1997:20; Abernathy et. al. 1999:59). The development of laser technology was especially important for developing barcode scanners. These scanners produce a light beam that is bounced off of the barcode symbol; white portions of the symbol reflect the beam while black portions absorb it. The reflected portion is sensed by a detector on the scanner and the associated software decodes it into a UPC. The UPC also had network externalities. Scanners were an expensive and useless investment unless the UPC symbol became common place, while the UPC was of limited use until scanners were common place. The inventors of the UPC did not believe that the system would work unless and until 75 percent of products bore the symbol and scanners had been installed in at least 8,000 supermarkets (Dunlop and Rivkin 1997:28).

¹⁷⁹ Scanners are accurate and mistakes are usually attributed to human error. A 1996 study concluded that scanners reduced pricing errors from 16 percent to fewer than 5 percent; the remaining errors came from failure to enter the new price into the computer system (Brown 1997:126, 129). The UPC replaced the price tag and allowed for instant price changes; removal of individual item pricing represented about 20 percent of the savings attributable to scanning.

The first item marked with a barcode and scanned at a supermarket was famously a double pack of Wrigley's chewing gum in 1974; a year after, 50 percent of items in supermarkets were on average source-marked with barcodes and thirty stores were scanning (Brown 1997:115). Having demonstrated its success, it spurred manufacturers of POS technology to produce reliable and inexpensive barcode readers, which led to more retailers adopting the technology (Dunlop and Rivkin 1997:9). In 1975, automated checkout counters proliferated throughout the grocery retail and manufacturing sectors, and beyond the grocery sector in the 1980s primarily due to Kmart and Walmart adopting the new technology. By 1994 there were over 110,000 unique manufacturer numbers and over 177,000 three years later.

5.1.2 POS-data

While increasing the productivity of checkout labour was the original impetus behind the development of the UPC and the barcode, the primary benefit has proved to be the ability to record data on individual exchanges and store it for future analysis. While this data was initially used for accounting purposes, it proved to be more use-valuable to the marketing and logistics departments of retailers and manufacturers (Borgos 2009:19). Walmart insisted on the compulsory adaptation of the barcode by their suppliers in order to increase the quantity and quality of the information it collected and thus to improve inventory management and their logistics (Cortada 2004:297; Lichtenstein 2009:41). James W. Cortada argues that although the central event in the history of IT in retailing in the latter half of the 20th century is currently the UPC and the barcode, it will prove to be the explosion of POS-data when future histories are written (2004:297).

Automatic collection of POS-data occurs at individual cash registers and primarily through scanning barcodes, but also with scales and keypads, and via customers swiping credit, debit, and loyalty cards. As soon as the barcode has been decoded into a UPC, this data is immediately communicated to the in-store computer to be stored, but is also used to look up the corresponding SKU and price in the retailer's inventory system to be added to the receipt and displayed to the customer. Whether daily or weekly, the in-store computer transmits aggregate POS-data on an item level to the company's central computer system which in turn communicates this data to the relevant distribution center

and/or supplier (Lynch 1990:158; Borgos 2009:19). In some cases, the individual scan may automatically trigger a replenishment process by its transmission to the retail store's distribution center, buyers, and/or suppliers (Dunlop and Rivkin 1997:10).

Thus, retailers get a direct data feed from customers in the form of POS activity by item (SKU and/or UPC). In addition to what the customer bought, the data collected identifies the price (including any discount), the time and place of purchase, how it was paid for (cash, check, credit, debit, or gift card), and so on. If customers use a loyalty or payment card, retailers can also record the identity of customers, which then can reveal how regularly they buy, their purchasing patterns, whether they are more or less enticed by promotions and discounts than other customers, and more (Webster and Robins 2004:71; Schmalensee and Evans 2009:53). Depending on what the retailer sells, other data may be collected. For example, apparel retailers will also collect data about the size, style, and colour of the garments purchased (Abernathy et. al. 1999:57). Online retailers have the ability to collect even more data from their virtual POS. For example, Amazon collects data on historical buying and browsing patterns, web pages visited, duration of viewing an item, overall length of visit to an Amazon site, links hovered over, and so on (Spiegel et. al. 2013:17).

Retailers collect an immense amount of data from the POS in this way. For example, Walmart captures every single exchange occurring at each of their retail stores, and every day records roughly 20 million customer transactions through its 140,000 POS-systems worldwide; this data is stored for at least two years (Petrovich and Hamilton 2006:133; Lecavalier 2010). In 1990, Walmart estimated it had 300 gigabytes of data; by the mid-1990s it had 44 terabytes, and by the end of the decade about 101 terabytes (Cortada 2004:309). This massive trove of information is stored in two data warehouses close to its headquarters in Bentonville; their system can handle over 570 terabytes of data and is second in capacity only to the Pentagon (Petrovich and Hamilton 2006:133; Haiven and Stoneman 2009:11).

Retailers mine their POS-data for patterns of exploitable customer behaviour and to develop predictive purchasing and distribution models. For example, retailers can

establish “item affinities,” i.e. find out what products are likely to be bought together and when. For example, after Walmart discovered that sales of beer and baby diapers rose in tandem on Fridays they decided to stock the two commodities near each other, to make it easier for a parent to pick up the two together and thus increasing sales of both items (Hoopes 2006:91; Lichtenstein 2009:43). By figuring out which commodities have the highest velocity, a retailer can place these on interior shelves to bring traffic down the aisles and consequently increase the probability of a customer picking up another commodity (Lichtenstein 2009:44).

Software packages associated with EDI systems also help to process POS-data for inventory and category management, and allows for the possibility of so-called “micromerchandising” whereby retailers tailor specific inventories for regions or even individual stores (which in turn determines the routing of specific commodities within the distribution center network) (Abernathy et. al. 1999:63). Marketers can also gauge consumer responsiveness to changes in price and non-price incentives like coupons and rebates, and special displays at the end of an aisle or by the checkout counter; the impact of promotions on related products and on sales beyond the promotional period (Borgos 2009:21). Mining POS-data enables diagnosis of the causes of the upturns and downturns of sales and whether any changes are temporary, seasonal, or long-term (Borgos 2009:20). For example, by analyzing POS-data, it is possible to figure out that increased sales came from advertising campaigns or in-store promotions, and whether other factors like promotions by competitors or even the weather affected the sales of a particular commodity.

The most valuable use of POS-data is, however, their use as corrective feedback for replenishment orders and production runs, the size and location of inventory, and the very movement of commodity capital through the sphere of circulation. In other words, POS-data is, as I argue in the next chapter, a logistical resource that is used to process the movement of capital (Manzerolle and Kjösen 2014). The collection of POS-data makes it possible to track inventory in real time, enabling automatic replenishment of orders, and, as the previous chapter argued, making it possible to move commodities through a distribution center network with unprecedented speed and precision (Dunlop and Rivkin

1997:12; Hoopes 2006:91). Collecting and sharing POS-data is consequently essential for the virtual integration of companies into a supply chain. For example, Walmart and Proctor & Gamble (P&G) became functionally interwoven after developing a real-time EDI link. This link gave P&G continuous data about the level of sales and inventory with the result that the order-to-delivery interval was reduced, and stock-outs were almost eliminated (Bonacich and Hardie 2006:172-3). The alignment of the circulation processes of Walmart and P&G can be explained in the following way:

When a bottle of P&G shampoo passes the bar code scanner at a Wal-Mart checkout counter, the information that the item has been sold is relayed directly to P&G each day. P&G then initiates the replenishment process, alerts Wal-Mart, and bills Wal-Mart without any purchase order being created. Moreover, P&G uses the data from Wal-Mart to adjust its manufacturing schedule. The entire transaction, from the transfer of the scanner data to the final transfer of funds from Wal-Mart to P&G is performed electronically (Dunlop and Rivkin 1997:12).

5.2 Payment systems

After a customer has paid for their commodities with cash, check or a payment card, the sum of money must be repatriated to the capitalist before it can be advanced again as capital. This reflux of money takes time. At the end of a business day, cash, for example, has to be accounted for, taken to a bank or cash deposit machine (or collected and transported in secure vans), and deposited in the company's bank account before this quantity of money can be spent or advanced as capital. The repatriation of money, especially in international trade, could take a long time prior to money becoming electronic or reduced to an accounting practice. The development of payment systems, however, gradually accelerated the repatriation of and customer access to money first through the personal check and later with payment cards.

While cash drawers and payment terminals are part of the POS-media system, they are access points for the separate but connected supply chain—the payment chain—for moving money. Particular payment instruments—cash, check, credit, and debit cards—have their own chains that connect payers with payees. A payment system typically consists of payment instruments, computers, and telecommunications networks, standardized banking procedures and regulations, and an interbank funds transfer system

to ensure the circulation of money (Rambure and Nacamuli 2008:xxii, 4).¹⁸⁰ With particular reference to the US check-clearing system and VISA, I discuss payment systems in terms of how they became adequate to the mode of production by reducing the time it took to process payments made by checks and payment cards. In order to explain this adequacy, it is first necessary to discuss in general what payment instruments and system are.

5.2.1 Payment instruments

According to David S. Evans and Richard L. Schmalensee, there have been four major historical innovations in payment: (1) the switch from barter to coin around 700 BC; (2) the introduction of checks (which is a promise of payment in money) by the Venetians in the 1100s; (3) the shift to paper money in the 1600s; and (4) the emergence of electronic money with payment cards and other instruments (2005:5, 27). In Marxist language, payment instruments refer to the natural form of money and is represented in coins and notes (cash), paper checks, and the electromagnetic pulses that transmit the funds transfer when using payment cards. These different payment instruments are effectively the “raw material” or content of payment systems (Rambure and Nacamuli 2008:23).

The definition of payment instrument, therefore, includes a transfer mechanism, agreed upon standards between payment service providers, and a legal framework for guaranteeing the debtor-creditor relationship (Rambure and Nacamuli 2008:4). The reason why payment instruments have different payment chains is that the final transfer of value will take a longer or shorter time depending on the particular instrument; with cash, debt is immediately extinguished, but remitting a check requires an institution to clear it (i.e. ensuring that the remitter has sufficient funds), which may take days. Any non-cash payment therefore involves an interval of time between payment and the actual transfer of monetary value, and includes the use of intermediaries: a service provider

¹⁸⁰ The cash payment chain also includes technologies like automated teller machines (ATMs), cash deposit boxes, and even armoured vans.

(usually a bank) that effect the debtor's payment and a settlement agent that discharges the obligation (usually a central bank) to the creditor (Rambure and Nacamuli 2008:4).

Payment instruments are also interesting to this dissertation because how people pay for things influences both what and how much is bought and how much money is spent. In general, people buy more and are willing to pay more if they pay with credit cards than with cash (coin and paper) or its equivalents (debit cards and checks). From bidding experiments, it has been demonstrated that people are willing to pay more for a particular commodity if they can pay with a credit card rather than with cash (Litan and Bailey 2009:14). Having access to credit also enables customers to finance purchases, thus encouraging people to buy something even if they lack money here and now. Most of us will use cash for small purchases, using cards for larger ones (Evans and Schmalensee 2005:122; Litan and Bailey 2009:2, 14; Stearns 2011:59). In other words, the velocity of money is higher if it is spent as credit rather than cash.

Cash (notes and coins) is the oldest payment instrument, has been used since exchanges moved beyond barter, and is still the predominant way in which people pay for things due to its convenience and simplicity (Rambure and Nacamuli 2008:25; Schmalensee and Evans 2009:41, 43). The advantage of cash is that it provides instant transfer of value and discharge of debt, but its disadvantages include being bulky and expensive to handle when it comes to transportation, storage, and security, in particular when the money is repatriated. A popular alternative to cash, particularly in the US and Canada, is the check, which is a "signed written payment instrument drawn by the debtor (or payer) on his/her bank and presented, either face-to-face or by mail, to the credit (or payee)" (Rambure and Nacamuli 2008:26). The use of checks have declined dramatically worldwide due to growth in electronic funds transfer, but in particular by direct payroll deposits and online bill payments (D'Silva 2009:24).¹⁸¹ The most significant trend in payment instruments is

¹⁸¹ In the US, paper is used for nearly half of all payments measured in dollar terms, with checks accounting for 35% and cash 14% (D'Silva 2009:23). In contrast, in Japan only 1% of transactions are made with check and about 50% with cash. According to Vijay D'Silva the reason checks still account for such a high percentage of transaction in the US relative to other countries is due to the early development of a reliable and efficient check payment system, and consumer inertia (D'Silva 2009:23-4). Sending

the general move towards electronic money, in which a computing device captures the transaction.¹⁸² The pace of technological change of payment instruments quickened in the second half of the twentieth century, in particular with the rise of the ATM in the late 1960s, and in the 1970s, the automated clearing house that can automatically process credit purchases and exchange funds electronically (Schmalensee and Evans 2009:42; D'Silva 2009:20-1).¹⁸³

5.2.2 The check clearing process

The automated clearing house, in particular in conjunction with credit and debit cards, is a payment system appropriate to the current period of the mode of production primarily because it repatriates money, at the speed of electromagnetic waves, to the circuit of capital's point of departure. In order to understand why and how this system is adequate, it is first necessary to discuss the system it remediated, namely the check. As opposed to cash as a direct embodiment of value, checks represent a tentative claim on value and must, therefore, pass through a logistical process of clearing and settlement. The attempt by banks to reduce the costs of dealing with this process is a direct antecedent to the rise

money electronically is, however, nothing new. In 1872 Western Union implemented a system for sending money via the telegraph. The company divided up its telegraph network into districts to which it assigned a superintendent. When a district superintendent received a confirmation from the sender's office that money had been deposited with Western Union, the superintendent would send a telegram to the recipient's office authorizing the payment (Standage 1999:113).

¹⁸² As of 2007 in the US, electronic payments accounted for two-thirds of all non-cash payments by volume and 45 percent by value (Schmalensee and Evans 2009:42).

¹⁸³ In 1975, banks introduced what today is the most commonly used card, namely the debit card. When this card is used, after payment has been authorized charges are immediately drawn from users' bank accounts (Litan and Bailey 2009:6-8). More recent payment innovations include PayPal, mobile payments, and the use of the smartphone as a payment device and replacement of both debit and credit cards. In addition to credit and debit cards, merchants in certain geographical regions also accept other forms of payment instruments. For example, in the London Underground, retailers are accepting payments via the NFC-enabled (Near Field Communication) Oyster card, which was developed for transit payments (D'Silva 2009:28). NFC-enabled smartphones are also increasingly used as payment devices, replacing credit and debit cards but not necessarily the payment system as such (Schmalensee and Evans 2009:65; D'Silva 2009:30; Manzerolle and Kjosen 2012; 2014).

of electronic money and the payment chain of credit cards (Evans and Schmalensee 2005:36-7; Litan and Bailey 2009:5).

The sequence of events involved in paying with a check are: (1) the creditor presents a check to his/her bank that verifies that the amount match in letters and figures; (2) the creditor's bank sends the check to the debtor's bank directly or via a clearing house, which; (3) sorts the checks received from collecting banks and sends them to the paying bank that; (4) verifies the debtor's signature and balance or credit line associated with the account; (5) notifies the creditor's bank that the check will be honoured or refused (or suspected of fraud); (6) and returns the check to the drawer with an account statement (Rambure and Nacamuli 2008:26).

In the nineteenth and early twentieth century US, this process was complex and time-consuming. Prior to when the Federal Reserve started a national check clearing network in 1915, to receive the full value written on the check—what is referred to as clearing the check at par—the holder (or an agent) had to present the physical paper check to the bank where it was drawn. If it was presented through the mail, the paying bank could discount the check, i.e. clearing it at less than its dollar value. Typically this discount was something the depositor paid for, which meant that there was little incentive for people to accept checks that were not drawn in banks other than their own (Evans and Schmalensee 2005:36-7; Stearns 2011:2). A method banks used to avoid paying discounts on local checks was to use messengers to each bank to present checks in person; but to make the process more efficient in areas where multiple banks operated, cooperative clearinghouses were formed where the messengers could meet to exchange checks (Evans and Schmalensee 2005:38-9; Stearns 2011:3).

The method for how banks avoided paying discount on out-of-town checks was related to how the checks were settled, i.e. how funds were transferred to the presenter. Settlement used to require the physical transportation of gold and/or coins and notes across the country, which not only took a long time but increased the risk of theft. Early in the twentieth century, banks sought to simplify the long distance transfer of material money by establishing so-called “correspondent relationships.” These relationships consisted of

banks making deposits with one another and then debiting or crediting these accounts when money had to be transferred. In this case, money was reduced to a mere symbol and transferring money became a mere book-keeping entry rather than involving the physical movement of paper, coins, or gold (Evans and Schmalensee 2005:39-40; Stearns 2011:3). Despite these cooperative relationships, the process of clearing and settling checks was still complicated:

The combination of correspondent relationships and clearinghouses created a complex, web-like network of banks willing to clear checks at par, and not surprisingly, banks went to great strides to leverage this network to avoid incurring discounts. There are legendary stories from the time of checks travelling ridiculous distances over circuitous routes to get to a paying bank that was relatively close to the originating bank. One story described a check that had travelled 1,500 miles over 11 days to get to a paying bank that was only 100 miles away. Another story told of a check that travelled 4,500 miles over two weeks to get to a competing bank that was only 4 miles away, only to find that there were insufficient funds, resulting in its return via the same route (Stearns 2011:3, see also Evans and Schmalensee 2005:40-1).

The correspondent relationships ended when the Federal Reserve established a national clearinghouse for checks. The transfer of funds between banks became an accounting practice of debiting or crediting a bank's reserve deposit account with the Federal Reserve. As David L. Stearns argues, this system had a subtle, unintended effect on the nature of money, making it more abstract and less of a thing. He writes: "The transfer of money no longer required the movement of physical objects, only the mathematical manipulation of numbers written in an account book" (2011:4). This transformation of money into "socially-guaranteed information" was necessary for processing payments over computer networks and for the emergence of automated clearing and settling houses of payment systems like VISA's and Mastercard's (Stearns 2011:4).¹⁸⁴

¹⁸⁴ The emergence of money as socially-guaranteed information answers Marx's question of whether money could be a pure symbol rather than also a commodity. He argues that for this to occur, "[o]ne thing is necessary... the symbol of money must have its own objective social validity" (Marx 1976:226).

5.2.3 Authorizing, clearing and settling credit card payments

The first types of credit cards were the so-called charge cards of the 1920s which were offered to customers by large-scale merchants or a network of merchants within a specific industry or geographic area, and later followed by department stores, oil companies, and airlines (Rambure and Nacamuli 2008:31; Stearns 2011:6-11).¹⁸⁵ The now ubiquitous plastic general purpose payment card that can be used at multiple stores began in 1950 with the Diner's Club, although initially it could only be used at select New York restaurants. The payment industry was revolutionized in 1958 when American Express and Bank of America (BankAmericard) issued credit cards that could be used at many different types of vendors. This feature attracted more users and merchants into their respective networks. What the credit card did was to use a card to identify an individual's bank account to a centralized credit system, which could be "accessed" from multiple locations (Stearns 2011:6).¹⁸⁶ Today, credit and debit cards, or rather specific payment systems like Visa and Mastercard, have become global common currencies, i.e. what Marx would refer to as world money (Evans and Schmalensee 2005:4).

Credit cards offer revolving credit where the holder can settle the full amount or pay a part of it upon receiving a monthly statement (Rambure and Nacamuli 2008:33-4).¹⁸⁷ Unlike cash and checks, merchants cannot accept your card unless they have entered into an agreement with an agent (acquirer) of the particular card brand; the acquirer provides authorization services to the merchant and a guaranteed payment within a set number of days after the charge has been authorized (Evans and Schmalensee 2005:119). To the

¹⁸⁵ Charge cards require that the holder pay off an entire month's purchase all at once (Stearns 2011:6).

¹⁸⁶ The concept of buying on credit did not come with the credit card. Most purchases in nineteenth century US were made on credit due to most consumers being farmers that received their income in bulk during harvest, but also due to the "chronic shortage of coins and the unreliability of paper currency" in that period (Stearns 2011:6).

¹⁸⁷ Prepaid cards (or stored-value cards) are for a fixed or re-loadable amount with the stored amount reduced by each purchase. These types of cards are typically used in closed systems for e.g. public transport or college meal plans (Rambure and Nacamuli 2008:34).

company that processes the transaction, merchants pay what is known as a merchant's discount, which typically is around 2-3 percent of the total of the transaction (Evans and Schmalensee 2005:3).¹⁸⁸ When paying with a card, payment is initiated by someone swiping a card through a payment terminal at a merchant who has signed up to a particular payment system (e.g. Visa or Mastercard). Within an agreed deadline, the acquiring bank credits the merchant with the amount, less the merchant's discount. The acquiring bank then obtains a refund from the issuing bank and through the scheme's clearing and settlement mechanism the cardholder is debited the full amount, which, if needed, is converted into the correct currency. The same process occurs when cards are used for withdrawal from ATMs not operated by the issuer's bank (Rambure and Nacamuli 2008:33).

Before the advent of ICTs, the process of authorizing, clearing, and settling transactions was cumbersome and time-consuming because everything was done with paper, postage, and telephone calls (Evans and Schmalensee 2005:73). If a customer initiated a purchase at a retailer and the purchase amount was below the merchant's floor limit, the transaction could be completed without authorization.¹⁸⁹ If the purchase was above this limit, the merchant had to call the credit card's authorization center to convey the transaction details verbally. First, the authorizer had to determine if the card was issued by the same bank (on-us) or another (interchange); if on-us, the authorizer consulted first a set of printed reports of "hot cards" (i.e. stolen or cards put on hold) to make sure the cardholder's name was not on the list; second, the authorizer searched through a massive binder of account sheets to review the details of the cardholder's account and a handwritten list of authorizations given since the report was printed. If everything was in

¹⁸⁸ In Marxist terms, the merchant's discount is a cost of circulation related to the imperative of value assuming the form of money (Marx 1978:213-4).

¹⁸⁹ The term "floor limit" came from department stores, where it meant the amount under which the floor staff could authorize purchases on credit without contacting the finance department. With credit cards, each merchant was assigned a floor limit over which the merchant was required to call the issuer for authorization to process the purchase (Stearns 2011:20, 30).

order, the authorizer gave the merchant an authorization code (a string of letters and numbers) for the merchant to write on the sales draft (Stearns 2011:30-1).

In the case of an interchange case, the merchant's authorizer would not have access to the account holder's name and therefore had to call the particular bank's authorization center, which would follow the same steps as just described. This process could take anywhere between five to twenty minutes. An implication of this latency was that merchants were disinclined to call their authorization center in fear of losing a sale (Stearns 2011:31).

Irrespective of being on-us or an interchange case, the merchant had to complete the sales draft upon authorization and put it together with the card into an imprinter to provide the customer and himself with a copy. After the details of the customer, merchant, and the purchase were on the sales draft, the customer provided her signature, which was checked against the one on the card (Stearns 2011:31-2). The merchant then deposited his copies to his bank and after a few days he would receive the funds less the discount. While the transaction is complete from the merchant's point of view, the actual clearing and settlement process has just started. The sales draft had to be sorted and totaled; banks with a low volume would do this manually, although banks with large volumes sent them to a data-entry department to be manually key-punched and proofed, and sorted by card number. On-us transactions were input into the bank's computer and added to the draft already drawn by the cardholder since the previous billing in order to generate a statement (with the paper drafts included) that was then sent to the account holder. Interchange drafts were grouped and totaled according to the issuing bank. The merchant's bank then completed a special clearing draft against all issuing banks that were sent through the federal check clearing system. All the individual physical sales drafts were, however, sent through the postal system so that issuing banks can process them as on-us payments (Stearns 2011:32).

By the 1970s the process of authorization was holding back the expansion of the credit card system because the slowness of the authorization process was affecting both the customer's desire to use the card and merchant's willingness to accept it. In 1973, the National BankAmericard Inc. (NBI) started developing the BankAmericard

Authorization System Experimental (BASE), which sought to automate authorization for their credit cards that were later branded as VISA.¹⁹⁰ BASE sought to accelerate the authorization process, eliminate floor limits, and institute better fraud control. BASE replaced the human authorizers with computerized logic, while the interchange problem would be solved with electronic communication between computers at different authorization centers (Stearns 2011:71-2). BASE was effectively an online computer network that connected all NBI member processing centers and electronic cash registers of large national merchants.¹⁹¹ With BASE, interchange authorization went down from five minutes to 45 seconds, and authorizations could be processed at any time. BASE II automated the clearing and settlement process with a central, batch-oriented electronic clearing house; BASE II was therefore the first example of an automated clearinghouse (Evans and Schmalensee 2005:125).

Instead of the cumbersome process of mailing paper drafts between members of the system, BASE II enabled exchange of the electronic records of transactions. With BASE II, members would additionally only settle with the clearinghouse and in net rather than with each other. The main problem in making BASE II work was to encode paper sales draft into an electronic format, which was first accomplished using optical character recognition (OCR) and later with payment terminals (Stearns 2011:96-7). Rather than the slow and inefficient process described above, the initial BASE II system would clear all sales drafts transmitted by all merchants overnight (about twelve hours); previously it had taken six to eight days for sales drafts to reach the bank of the credit card holder (Stearns 2011:96, 99, 102). In the 1980s, the settlement process was automated with BASE II transmitting net settlements electronically to a clearing bank. Until the later advent and widespread use of POS payment terminals, paper was eliminated in the

¹⁹⁰ NBI was founded by the various BankAmericard issuing banks after Bank of America gave up control of the BankAmericard program.

¹⁹¹ For a history and technical details of this system, see Stearns (2011:72-85),

clearing and settlement process but for the necessity of merchants creating sales drafts at the point of sale (Stearns 2011:99, 101).¹⁹²

5.2.4 The machine-readable credit card and payment terminal

If the VISA payment system was to become a replacement for cash and checks, the first link in the payment chain had to be fully automated even at small merchants. Automating the first link in the payment chain meant eliminating paper sales drafts in favour of beginning all transactions in electronic form. This elimination required two things: (1) a terminal to read cards directly; and (2) a standardized machine-readable card (Stearns 2011:135).

The standard credit/debit card is 3 3/8 inches long by 2 1/8 wide, has a magnetic stripe on the back, and the holder's name and a thirteen to sixteen-digit account number on the front (Evans and Schmalensee 2005:1).¹⁹³ The digits with their link to the holder are what is important; how they are stored and transmitted is up to the payment chain of specific payment systems. A machine-readable card was accomplished by encoding the card's details onto a magnetic stripe, which is a piece of magnetic tape that is affixed to the credit card and onto which binary data can be encoded; it is decoded by passing the tape over or through a reader (Stearns 2011:140).¹⁹⁴

¹⁹² With the implementation of BASE I and BASE II, the founder and former CEO of Visa, Dee Hock, realized that money had been reduced to "guaranteed alphanumeric data" and that banks were institutions for the "custody, loan, and exchange" of this data (Stearns 2011:44). He also realized that since this data was manipulated by computers, it could be sent worldwide at the speed of light and at minimal cost and alphanumeric data might form the basis of a new type of global currency (Stearns 2011:44). Hock argued that Visa was not in the credit card business because the credit card is merely a device for bearing the "symbols for the exchange of monetary value", while their business was rather "*the exchange of monetary value*" (in Stearns 2011:45).

¹⁹³ As with the standards of the container box, the standardized payment card allowed for interoperability between different technical systems, such as payment terminals and ATMs.

¹⁹⁴ A magnetic stripe "contains a large amount of contiguous ferrite-oxide particles, and it is somewhat arbitrary how one divides them into discrete segments representing binary values" (Stearns 2011:141).

While there are different types of payment terminals available to retailers, most have the same basic functionality allowing a customer or merchant to insert, swipe, or manually enter the debit/credit card information to initiate an electronic funds transfer (see Figure 32). The majority of these terminals transmit data over a telephone line or an internet connection. Although the first terminals performed authorizations only, by the mid-1980s most terminals supported data capture, which allowed for storing the details of individual transactions and their electronic transmission to acquiring processors (Stearns 2011:154).



Figure 32: Payment terminals (Source: barcodesinc.com)

The payment card and terminal are, however, just the front-end of a large system that is based on mainframe computers, servers, proprietary software, and multiple different institutions. Albeit slightly dated hypothetical scenario, Evans and Schmalensee describe what happens when you pay with a Visa card and thus how commodities are actually transformed into money when paying with plastic. After swiping, inserting, or tapping your card on a payment terminal, the

card reader takes data off the magnetic stripe on the back of the card. It combines this data with information about the merchant and the dollar value of the purchase to create an electronic message. It then dials the telephone number of the computer maintained by Best Buy's "acquirer" (the bank that handles its Visa transactions). Once connected, a message is sent to the acquirer's computer. This computer reads the message and figures out that you have used a Visa card. It dials up Visa's computer system (there are actually two that work in parallel just in case one of them goes down). After reading the message, Visa's computer knows to check with Bank of America's computer to see whether you have enough

money on your credit line to cover the purchase. If you do, Bank of America's computer will send a message back to Visa's computer authorizing the transaction, Visa relays the message back to Best Buy's acquirer, which then sends a message back to the terminal at the store. The terminal prints out the receipt that you sign... The authorization process usually takes just a few seconds. Best Buy then automatically submits a request for payment to its acquirer, which in turn sends it on to Visa's computer. The Visa computer passes on the request to Bank of America's computer, which posts the transaction to your account. Visa's computer consolidates this transaction with all the other Visa transactions and settles accounts among banks. For this purchase, Bank of America pays the acquirer, which pays Best Buy. This process is typically completed within two to three days from the time you made your purchase. The Best Buy store receives about 98 percent of the amount charged... The remaining 2 percent difference is called the "merchant discount", which is the fee paid to the acquirer for providing its services (Evans and Schmalensee 2005:9-11).

And with that the commodity's formal movement is complete because it has been turned into money; it has gone to market and performed exchanges. In the following, concluding chapter, I discuss how the various media systems discussed in these last three chapters function within and for the circulation process of capital. That is, I explain in what sub-category of capital's media they appear.

Part 3: Capital's Media

6 The Media Form

The previous three chapters narrated how the formal movement of commodity capital is materially mediated in time and space. This material mediation can be illustrated in the following way. A batch of coffee makers has been produced at a factory in Shenzhen, China. The preparation of this commodity for circulation starts with the coffee makers being placed in *consumer packaging* that is marked with *barcodes*. These packages are placed in larger *corrugated cardboard boxes* onto which *Walmart compliant labels* are affixed. These boxes are loaded into several *standard containers* that are moved by *trucks* to the *port* of Shenzhen where *quay cranes* load the containers onto a *container ship* headed for the port of Long Beach, California. After the containers have been unloaded in Long Beach, they are placed on *double-stack railcars* headed for a Walmart import *distribution center*. At the distribution center, the containers are emptied, and the packaged coffee makers are consolidated into truckloads headed for regional general merchandise distribution centers throughout North America where they will be cross-docked. At the regional distribution center, the trucks are unloaded, and the packages are oriented so that their barcodes and labels can be read by the automated *conveyor system*, which quickly routes the packages onto an outgoing truck headed for one of Walmart's many retail stores. At the retail stores, the coffee makers are placed on the retail floor in their consumer packaging. When a customer buys a coffee maker, the *POS-system* scans the barcode to look up its price and to update the store's inventory. The customer pays for the coffee maker by swiping her *credit card* through a *payment terminal*, which initiates the process of clearing and settling the purchase taking a few seconds, after which the money has changed hands for this particular commodity. After a short time, the money is repatriated back to Walmart minus the merchant's discount.

Everything italicized in this description are things that function as capital's media. But what is capital's media? As I stated at the outset, the purpose of this dissertation is to develop capital's media as a category, and that the process of elaborating such a category cannot start with things that are always already identified or pre-defined as media, be it the mass media, the intermodal transportation system, distribution centers, and so on.

Such an approach would be to argue that things *by their very nature* are media, which would amount to a fetishism of media. In this chapter, I justify why *things are capital's media when they appear in the form of media*. More specifically, a thing, such as a container ship or distribution center, appears in the form of capital's media *when they function within and for the circulation process*.

It is the focus on function that is important in defining capital's media as a form. This emphasis concerns a methodological point made by Marx in his critique of political economy. Although I quoted Marx on this point in the introduction, due to its importance for this chapter, I reiterate it now. Marx attacked the fetishism peculiar to bourgeois economics that “transforms the social, economic character that things are stamped with in the process of social production into a natural character, arising from the material nature of these things” (1978:303). The bourgeois economist “is unable to separate the form of appearance from the thing which appears in that form” (1976:714). For Marx, the point is therefore not to come up with “a set of definitions under which things are to be subsumed. *It is rather definitive functions that are expressed in specific categories*” (1978:303, emphasis added).

Developing media as a form thus depends on identifying the functions that media as a category expresses. Indeed, without delineating these functions, the media as a category has no content. In this chapter, I argue that the functions that are expressed in the category of capital's media are, with some modifications, the functions that Canadian-German media theory refers to as transfer, storage, and processing. Hence, in order to develop ‘capital's media’ as a category, I juxtapose Marx's value theory with how Harold Innis, Friedrich Kittler, Wolfgang Ernst, Hartmut Winkler, and Paul Virilio to conceptualize these media functions. The argument proceeds as follows: I first clarify the relationship between capital's media as a form and the social forms of capital, arguing that the latter comes to form-determine the former. I then start to delineate the functions of capital's media and clarify how the functions of media theory can be brought to bear on phenomena that are material objects, as well as the cultural knowledge and data streams on which media theory focuses. I then develop media theory's functions of transfer, storage, and processing into the functions expressed in the category of capital's

media, arguing that they each contribute to overcoming what Marx referred to as the “barriers” to capital in circulation; capital’s media as a category expresses how these barriers are overcome.

6.1 Capital’s media, its contents, and relationship to economic forms

That things function as media for capital within and for its circulation process means that there is a relationship between the media form and the social forms that capital assumes in circulation. Clarifying this relationship is the first step in translating the functions of media theory so that they can be expressed in the category of capital’s media. First, a caveat: although I speak of capital’s media as a form or category in which things appear, I am not arguing that the media form is equivalent to Marx’s social forms, which are the theoretical expressions of the relations of production. In other words, the media form is not a further mediation of the class struggle (see Rubin 1973; Bonefeld 1987; Gunn 1987). Consequently, I do not argue that the category of media should or even can be developed in the exact same manner as Marx’s economic categories, but that in developing the media category, form should be stressed over content.

When Marx writes about functions, he is referring to social functions that things, in addition to their natural characteristics, gain by virtue of existing in a particular society. A container ship is an example of a thing that I argue functions as a medium of transfer for capital due to its capacity to transport commodities. But this capacity is not, however, a characteristic particular to the society in which it appears, but comes from its natural form being composed of a keel, deck, holds, cell-guides, an engine, and so on.¹⁹⁵ By arguing that the container ship is a medium for capital, I imply that there is a relationship between media theory’s functions and how capital’s formal movement is materially

¹⁹⁵ An argument could be made, however, that certain transportation vehicles come to be specifically engineered for the transportation of commodities—far more so than previous types of shipping—and, therefore, its material characteristics would reflect aspects of society in which it exists. For example, the monstrous size of container ships is a case in point.

mediated. Developing the capital's media as a category, therefore, requires a clarification of the relationship between capital's media and the social forms of capital in circulation.

Keeping form and content (natural form) distinct is necessary to avoid a fetishism of media, but to also justify why some things that Marxists normally would analyze as machinery can instead be analyzed as capital's media. Making this distinction is also necessary in order to understand that the physical conditions of circulation (i.e. media systems) I discussed in the previous three chapters refer to the natural forms (content) of capital's media. That certain things like barcodes, packaging, and the commodity's guardian appear in the category of capital's media is, however, dependent on one vital condition, which precisely concerns the relationship between capital's media and circulating capital. To explain this condition and relation, I draw on Marshall McLuhan's (1994) argument that media are extensions.

Capital's media can be understood as *extensions* of commodity capital and money capital. In other words, capital's media extend either the commodity or money. A direct implication is that the media category is subdivided into media for commodity capital and media for money capital. McLuhan argued that media were the extensions of man and that an "extension appears to be an amplification of an organ, sense or function" (1994:187). For example, clothing extends our skin to keep us warm in cold weather, wheels extend our feet to make us go faster and further, and electricity extends our nervous system and so on. In other words, extensions "add [themselves] on to what we already are" and "amplify or accelerate existing processes" (McLuhan 1994:12, 8). For McLuhan, the medium (or form) is, therefore, the message rather than its human-meaningful content.

Kittler remarked that McLuhan's extensions were too human because "he attempted to think about technologies in terms of bodies rather than the other way around" (2010:29). Taking Kittler's advice, it is possible to apply the notion of extensions to the non-human economic forms of capital in circulation. Indeed, I already did this in chapter one when I posited the commodity's guardian as a vehicular prosthesis of the commodity. As an extension, the guardian "added" itself onto what the commodity already is; and what the

commodity is, is best described by its social function as contained in the statement “go to market and perform exchanges.” But why is media an extension of capital in circulation considering that the content (natural form) of the media form are things like standard containers and ports? How precisely does the medium add itself onto what an economic form already is?

In order to answer these questions, it is first of all necessary to understand that the same thing can appear in different economic forms simultaneously. Marx illustrates this dual functional existence with reference to the transportation of cotton and coal:

As long as cotton and coal are in transit, they cannot serve as means of production. They form instead the object of labour for the transport industry and the capital employed in it, and commodity capital in circulation for the coal producer or the cotton broker (1978:366).

The cotton and the coal are at the one and the same time, albeit from different points of view, both productive capital and commodity capital. The salient point for a theory of capital’s media, however, is that the commodity capital of the coal producer or the cotton broker is the material content—the cargo—of the vehicle that transports it. The condition for something functioning as a medium for capital is therefore that it must have either commodity capital or money capital as its cargo-contents.

The relationship between on the one hand the media form and its content (e.g. a truck), and, on the other hand, the economic category and its content (e.g. cotton) is like a Matryoshka doll; the cotton appears in and is the content of the commodity form; the cotton commodity is, in turn, the cargo of the truck that transports it; this vehicle, therefore, appears in and is the content of capital’s media as a category.¹⁹⁶ It is only in such a relationship that a medium for capital extends one of capital’s particular forms in circulation. By virtue of this relationship, the social function associated with the economic category is amplified or accelerated.

¹⁹⁶ To put it differently, the truck is a medium for capital only because the cotton it transports appears in the social form of the commodity and is the circulating capital of another independent capital. The same would be the case if the truck was armoured and transported the money capital in another circuit of capital.

The converse of this argument is that if, say, a container ship is not carrying commodity capital, however, as unlikely that would be, it would not function as a medium for capital. An empty container box is, in other words, not a medium for capital, although it may still be a constant component of its owner's productive capital. Likewise, a container filled with the contents of my apartment would not be a medium because my personal belongings are use-values without social form.¹⁹⁷ The same would even be the case for a truck when it leaves empty after having delivered its truckload of commodities to a distribution center.

What about form-determination? After all, I have just attempted a form-analysis of media. Although the thing appearing in the media category is determined by it in the sense of having a definitive media function, the source of this determination is the social form. Capital's media adds itself onto what the commodity and money already are; what they are is best explained in terms of their contradictory immanence because it gives rise to specific social functions. Marx explains these functions in several different ways, respectively as selling and buying, metamorphosis, or, what I prefer, the individual formal movements $C'—M'$ and $M—C$. As I argue below, media of transfer, like the truck, accelerate these movements materially and extend them in space and time; media of storage amplify the shelf life or reduce the circulation time of the commodity; and media of processing give these movements direction and schedules it in time.

Fundamentally, the reason why capital's media are needed in the first place is due to the immanent contradiction of the commodity. The imperative of value to appear in its form requires the material movement of the sensible commodity. When a Triple-E class container ship transports commodity capital it, like the commodity's guardian materially mediates the commodity's function in geophysical space. Thus what drives the Triple-E class container ship forward is the immanent contradiction of the commodity as much as its massive diesel engines.

¹⁹⁷ That I would have to buy the use of this container and its change of location as a commodity from a moving company is immaterial.

6.2 Media Functions

Capital's media have both general and particular functions. The general functions are common to all of capital's media, which means that the general functions are the aggregate effects of the particular media functions of transfer, storage, and processing. While the general functions are expressed in the category of capital's media, the particular functions are expressed in the subcategories of capital's transfer, storage, and processing media. Capital's media is thus a super-category that is divided into media for commodity capital and money capital; in turn, these categories are subdivided into transfer, storage, and processing for a total of six categories. These categories, therefore, reflect capital's media ontology. While I have referred to the general functions of capital's media in previous chapters, I postpone their reiteration until I have discussed the particular media functions.

By referring to transfer, storage, and processing, I am arguing that the particular functions of capital's media are, albeit with some necessary modifications, those of Canadian-German media theory. The task at hand in the following sections is to discuss how these functions, which were first investigated in regard to cultural communication (Innis 2007; 2008) and then applied to optical, acoustic, and symbolic data streams, can be used to explain how capital's formal movement is materially mediated as moments of transfer, storage, and processing. The problem that has to be solved is that the circulation of capital is not specifically concerned with cultural communication or the data streams *as such*, but with a quantity of 'capital value' in various economic and material guises. While these material forms include commodified cultural items (e.g. news and literature) or data streams (e.g. recorded and broadcast music, video, and text), they also, include things like food, coffee makers, and action figures. The question then becomes, how are these material objects transferred, stored, and processed?

6.2.1 Particular functions

In *Empire and Communications*, Innis (2007) narrates the history of Western civilization as a balancing act between time-based storage media and space-biased media for transportation and transmission:

The concepts of space and time reflect the significance of media to civilization. Media that emphasize time are those that are durable in character, such as parchment, clay and stone. The heavy materials are suited to the development of architecture and sculpture. Media that emphasize space are apt to be less durable and light in character, such as papyrus and paper. The latter are suited to wide areas of administration and trade... Large-scale political organizations, such as empires must be considered from the standpoint of two dimensions, those of space and time, and persist by overcoming the bias of media which over-emphasize either dimension (Innis 2007:26-7).

In this uncharacteristically lucid passage, Innis defines media in relation to the concepts of time and space, states that a medium's material characteristics make it biased towards one or the other, and reveals his iconoclastic understanding of media by identifying architecture and sculpture as examples next to clay and stone, and papyrus and paper. Innis effectively argued that cultural communication in a civilization can be understood as a choice between space (transfer) and time (storage).

Following Innis, so-called German media theory adopted these two media functions but applied them to the abstract acoustic, optical, and symbolic data streams. In Kittler's more technical language, drawn from Claude Shannon's information theory, media refers to the communications channels that are either "equipped for the technical bridging of space in the case of transmission media or of time in the case of storage media" (2010:46). The shift in focus towards data streams led Kittler to introduce the media function of processing, thus turning Innis' binary into a trifecta (1996; 1999; Krämer 2006).

As I noted in the introduction to this dissertation, Parker considered Innis' post-staples scholarship to deal with the "economics of communication," which concerns the "study of the determinants of the structure of spatial and temporal relations within and between open economic systems" (1981:129). Due to existing in time and space, open economic systems require "anti-entropic activity" for their reproduction (Parker 1981:130). These activities include: (1) transportation through time between points in space; (2) translation through time of material goods without a change in location (storage and materials handling); and (3) transmission of property claims to resources (including monetary transfers). In other words, anti-entropic activity refers to the media functions of transfer

(transportation and transmission) and storage. Although Parker does not refer to processing, I consider this function to also be anti-entropic. But why are they qualified as anti-entropic?

While media in general function to reproduce open economic systems, to persist through both time and space, a civilization must overcome the bias of media that over-emphasize either dimension or else face eventual disintegration. Space-biased societies are dependent on light and portable media, such as papyrus or modern electronic media that allow for fast movements over large distances and thus for maintaining territorial control through administration, trade, and the military. Time-biased societies, however, rely on heavy and durable media, such as clay and stone that enable transmission of culture through time and thus the maintenance of tradition. Media bias can, therefore, be understood as a medium's particular capacity to overcome, bind, bridge, or organize space and time in accordance with a given political, economic configuration. While a time-biased medium can endure the ravages of time, it is not suited for transport and the reproduction of a society in space; a space-biased medium can be easily transported but its fragile or perishable characteristics means that it is not suited for reproducing society in time (Innis 2007; 2008; Heyer and Crowley 2008:xxxiv-xxxv; Watson 2008:xix; Manzerolle and Kjøsén 2015:162).¹⁹⁸

The particular functions of transfer, storage, and processing should also be understood as anti-entropic and therefore as contributing to the reproduction of capital as an open economic system. In this reproduction, capital's media also function to overcome, bind, organize, or control space and time but only insofar as they are barriers to capital in circulation. In general, capital's media function to overcome barriers, and each of

¹⁹⁸ Innis importantly argues that the bias of a dominant medium of any civilization conditions the way in which members of society appraise problems—be they cultural, social, political or economic—in terms of space or time. A space-biased society, such as any contemporary capitalist one, is prone to resolve problems with military force rather than diplomacy, and are oriented towards the present to the neglect of duration, the past, and the future. Such a society will not be able to reproduce itself through time unless it is balanced with anti-entropic time-biased media. The current neglect of environmental degradation and depletion of natural resources for short-term profit are salient examples of our current incapacity to appraise problems in terms of time.

capital's particular media overcome one or more of capital's five barriers in circulation. In order to continue the modification of media theory's functions, it is necessary to introduce the concept of "barrier."

6.2.1.1 Barriers to capital

In *Grundrisse*, Marx argues that capital posits barriers against its free functioning and boundless expansion. Barriers delay the movement of capital in its circuit from one form, stage, and sphere to the next, and/or limit the quantity of surplus-value that is produced and realized within a given period (Marx 1973:421, 524, 538-9; Negri 1984:114-19; Manzerolle and Kjosen 2012:219-21). In other words, barriers block the movement of capital and force capital to get around, lower, or somehow eliminate them in order to reproduce itself. While barriers can be thought of as nuisances that merely impede the movement of an individual capital, they can, as Michael Lebowitz (1982) argues, also lead to a crisis for capital as such.¹⁹⁹ According to Marx, there are barriers in both the sphere of production and in the sphere of circulation. In this dissertation, I primarily focus on the barriers Marx discusses in *Grundrisse* because it is in this collection of notes that he systematically discusses barriers and presents a narrative of their overcoming.²⁰⁰

In *Grundrisse*, Marx identifies necessary labour as a barrier in the sphere of production, and the barriers of use-value (need), equivalents (money), space, and circulation time in the sphere of circulation (Marx 1973:405-10; 542-3).²⁰¹ To these circulatory barriers, I

¹⁹⁹ Whereas Lebowitz (1982:6) argues that a crisis reveals the existence of a barrier, I argue that the barrier is always already there and is something that logistics experts deal with daily.

²⁰⁰ Marx does mention the concept of barrier in each of the three volumes of *Capital*, although not as systematically as in *Grundrisse*. While barrier is mentioned ten times in *Capital Vol. 1*, he mentions it in reference to necessary labour, raw material, and laws, but does not explain what he means by the term. In *Capital Vol. 2*, he mentions barrier only once, but a whopping 83 times in *Capital Vol. 3*. In neither of those volumes, does he explain his use of the concept. In *Capital Vol. 3*, it should be noted, barrier is mainly discussed in terms of the falling rate of profit (Marx 1981:358).

²⁰¹ When it comes to barriers a distinction can be made between machinery and media. Whereas machinery overcomes a barrier that is internal to capital, namely necessary labour, media overcome those barriers that are external to capital. I base this argument on what Vincent Manzerolle and I have argued before, that "capital relies on various media technologies to overcome these barriers" (2012:219; 2015;

add the only barrier Marx discusses in *Capital Vol. 2*, namely use-value (perishability) (Marx 1978:206). There is thus a total of five barriers to capital in circulation that capital's media overcome, bridge, or control. I argue in the following sections that capital's transfer media overcome the barriers of space and time; capital's storage media overcome the barrier of use-value (perishability), and capital's processing media overcome the barrier of use-value (need). The barrier of equivalents is in a special category of itself. Before I explain the relationship between particular functions and barriers in more detail, it is necessary to explain why capital must overcome its barriers.

If barriers block the free functioning and boundless expansion of capital, it follows that capital tries to overcome them in order to "release its own potency" (Negri 1984:115). The potency should be understood in terms of the purpose of the capitalist mode of production which is to produce surplus-value and accumulate it as capital. I argue, however, that it can also be tied to how the mode of production gains elasticity (see chapter two). Production cannot expand by leaps and bounds unless the barriers to capital in circulation are overcome; it is by overcoming these barriers that capital's media in their particularities contribute to giving the mode of production elasticity and also how they function to materially mediate the formal movement of capital. Thus more generally, the potency of capital is (completely) released if it can move through its circuit without friction, i.e. as if it had no barriers.

Marx's conceptualization of capital as a circuit is derived from Hegel's "Concept" (or Notion) in the sense that both are movements of a universal concept that constitute themselves through a succession of stages and particularities (Arthur 1998). But as I argued with reference to Marx and Reichelt in chapters one and two, capital is not a mere abstraction, but an abstraction that is perpetuated by the movement of matter. That capital "must invest itself in matter, something that may in fact be resistant to it" (Arthur

259). Thus my argument is a subtle specification that overcoming the barriers of space and time is a media function expressed in the concept of the category of capital's transfer media.

1998:117), means that it is not a guarantee that capital will complete a turnover. Marx explains this problem in the following way:

The three processes of which capital forms the unity are external; they are separate in time and space. As such, the transition from one into the other, i.e. their unity as regards the individual capitalists, is accidental. Despite their inner unity, they exist independently alongside one another, each as the presupposition of the other. Regarded broadly and as a whole, this inner unity must necessarily maintain itself to the extent that the whole of production rests on capital, and it must therefore realize all the necessary moments of its self-formation, and must contain the determinants necessary to make these moments real (Marx 1973:403).

What is important to draw attention to in this quote is first of all that the requirement of capital to maintain its “inner unity”— which should be understood as the formal movement of capital through its circuit and capital’s reproduction—comes into conflict with its physical existence in time and space. As I argued in chapter two, the circuit’s three processes of purchase, production, and sale refer to geographical locations and specific points in a supply chain that may be continents apart. Space and time thus contradict the inner unity and friction-free movement of capital, and therefore form two important barriers to capital in circulation (Marx 1973:534, 538-9). The anti-entropic activities of transfer, storage, and processing are therefore necessary to maintain the inner unity of capital in space and time. To put it differently, if capital’s media cannot overcome the barriers of space and time, capital will slide into disorder in the sense of value dissipating from the circuit.

In *Grundrisse*, Marx presents a narrative of barriers because, as Antonio Negri argues, overcoming a barrier is a temporary measure and merely constitutes an “endless re-positing of the obstacle” (1984:116). He argues further that although barriers are “defined first, at the level of circulation,” they are in the end “reconfigured on the terrain of production” (1984:117). Marx, however, argues that the expansion of production is “absolutely identical here with the positing of barriers to the sphere of exchange, i.e. the possibility of realization” (Marx 1973:422). According to Lebowitz, this argument means that what “capital does in the sphere of production comes back to haunt it in the sphere of circulation” because it has the “tendency to expand production without regard for the

limits posed by itself, without regard for the limits of a sphere of circulation marked by capitalist relations of production” (1982:17).²⁰² Both Negri and Lebowitz are correct. Only production based on wage labour presupposes circulation, which means that circulatory barriers exist because of capital; at the same time the barriers in circulation act recursively on the sphere of production by in the end being repositing into the barrier of necessary labour, which therefore limits the production of surplus-value.²⁰³

Marx’s narrative of barriers and their repositing in *Grundrisse* starts with use-value (need). While it is an imperative for any capital to realize surplus-value by selling commodities, the commodity itself contains a barrier that contradicts the sale: “the barrier consisting of the need for it... the total need of all those engaged in exchange” (Marx 1973:405). If there is no longer any need, it becomes impossible to sell any more commodities. In the argument Marx presents, the barrier of use-value (need) is overcome by “*the production of a constantly widening sphere of circulation*” (Marx 1973:407).²⁰⁴ Although I argue that the barrier of need is overcome by capital’s processing media, Marx indicates that it is first overcome by the means of transportation. A widening sphere of circulation means that capital expands the market for its commodities in order to find new customers willing to buy; having a larger spatial orbit, however, means that the commodity’s social function of “going to market” involves greater distances. Capital overcomes the barrier of need by extending itself in space, but this overcoming merely repositing this particular barrier as a spatial one, which in turn must be overcome for the

²⁰² For example, if capital produces more than a given geographic area can consume, then capital is left with unsold commodities, meaning that the barrier of use-value (need) has manifested itself. This dynamic can be connected to adequate and inadequate means of communication and transport; if capital produces commodities at a pace and volume that its media cannot deal with, the barriers of space and time loom on its circulatory horizon.

²⁰³ When I turn to the barrier of (circulation) time in the section on transfer, why this repositing occurs will become clearer.

²⁰⁴ “The need of a constantly expanding market for its products chases the bourgeoisie over the whole surface of the globe. It must nestle everywhere, settle everywhere, establish connections everywhere” (Marx and Engels 1998:39).

commodity to perform exchange. The barrier of space is overcome by capital's transfer media.

6.2.2 Transfer

Whereas media theory's function of transfer overcomes only space, capital's transfer media overcomes the barriers of both space and time. In media theory, transfer broadly refers to a type of movement that overcomes or bridges space and is thus equivalent to the technique of sending. The transfer function can be divided into transportation and transmission, with the latter referring to cases where the message is divorced from the messenger. Speed or acceleration is thus part and parcel of the transfer function, and the difference between transportation and transmission can be explained in terms of speed (Innis 2007; Kittler 2010:48; Peters 2010:12).

The immediate problem in translating media theory's function into a function of capital's media, therefore, concerns why the latter overcomes time as well as space.²⁰⁵ The space overcome by the function of transfer is large and geographical, and concerns territorial integrity, trade, and administrative and military control over large stretches of land (Innis 2007; 2008:92-131; Winkler 2009a). Transfer, however, is a process in time as much as a phenomenon occurring in space. Winkler stresses that the process of overcoming space takes or consumes time (2009a:9). Transporting a letter from A to B will take more or less time depending on the distance between the two points given that speed is constant, but with faster movement, the distance will be covered in less time. That overcoming space takes time is an important clue as to why capital's transfer media overcome both space and time, and why the barrier of space is turned into a barrier of circulation time.

Marx also assumes a difference between transportation and transmission, arguing that the communication industry carries them out as the distinct activities of transportation

²⁰⁵ The reasons for this difference, however, pivot on the problem of storage: storage is, as Parker (1981:130) argues, a "special case of transfer" in the sense that it is a "translation through time" of material objects, which cannot be frozen in and thereby overcome time like a temporal data stream. While I discuss this problem in more detail in the section on storage, I signpost it now to indicate that the time capital's transfer media overcome is different to the time media theory's storage function overcomes.

“moving commodities and people” and the “transmission of mere information” (Marx 1978:134).²⁰⁶ The way in which Marx understands the function of transportation is for all intents and purposes the same as that of media theory: transportation equals a “change in spatial location” (1978:135), i.e. an overcoming of space. The spatial barrier, therefore, presents itself as a logistical problem of getting commodities from point A to points B, C..., and Z. But is this really the case? In *Grundrisse*, Marx famously wrote that

while capital must on one side strive to tear down every spatial barrier to intercourse... it strives on the other side to annihilate this space with time, i.e. *to reduce to a minimum the time spent in motion from one place to another...* the more extensive the market over which it circulates, which forms the spatial orbit of its circulation, the more does *it strives simultaneously for an even greater extension of the market and for greater annihilation of space by time* (Marx 1973:539, emphasis added; see also, 1973:524; 1978:329).

In this passage, Marx argues that overcoming space is more precisely a matter of the time it takes. That transfer takes time in overcoming space is therefore salient for thinking through the function of transfer as brought to bear on the circulation of capital.

Following Winkler, Marx’s argument that circulation “proceeds in space and time” (1973:533) can be re-written as “because circulation proceeds in space, it takes time.” The implication of this subtle change is that the transfer function is not only about overcoming space but also about acceleration. As Marx argues, “even spatial distance reduces itself to time; the important thing... is not the market’s distance in space, but the speed—the amount of time—with which it can be reached” (1973:538; see also 1978:327). That the means of communication and transport overcome the barrier of space by reducing the time it takes to traverse a given distance means that the *function of capital’s transfer media is therefore more appropriately acceleration*.²⁰⁷

²⁰⁶ Marx’s understanding of transmission, however, does not exclusively refer to sending a message without the need for a messenger; while he includes telegrams in transmission, he also refers to letters (1978:134).

²⁰⁷ From a supersensible point of view, Marx argues that speed is a “moment” of capital’s circulation process (1973:516).

That Marx immediately refers to time in explaining how capital's spatial barrier is overcome, means that this barrier is not really overcome but, repositioned as yet another barrier, in this case, that of (circulation) time. The only way in which this barrier can be overcome is with even more acceleration, albeit with transmission rather than transportation. I am, however, getting slightly ahead of myself because I have yet to explain what makes space and time barriers to circulation. How precisely do capital's media overcome space? What are the respective contributions of infrastructure and vehicles in overcoming space and time? Answering these questions requires a better understanding of what the barriers of space and time are because only then it is possible to discuss how they are actually overcome.

6.2.2.1 The barrier of real space

Beyond taking time and involving great distances, Marx does not explain why space is a barrier. In order to discuss why space is a barrier in more depth, I draw on Virilio's concept of real space. According to Virilio (1991; 1997), real space refers to the space of geography and geophysics. It is thus substantial and material; it possesses volume, mass, and density; gravity, weight, and extension. In terms of geography, real space concerns extension (distance) and the lay of the land, and how the surface of the earth with its mountains, valleys, rivers, trees, and other geographical features represent so many obstacles to fast movements and acceleration. In geophysical terms, real space includes the physical processes and properties of the planet, such as its gravitational and magnetic fields, and the centripetal forces that condition movement and set the speed limit for the physical displacement of matter.²⁰⁸

Arthur's argument that capital must invest itself in matter that may be *resistant* can now be understood in terms of the geophysical properties of real space. The matter of capital, as well as its media, exists in real space and in its movement is therefore conditioned by

²⁰⁸ Below the speed of escape velocity (11,2 km/s), all movement is affected by earth's gravity well and is subject to centrifugal and centripetal forces, and resistance to forward motion (Virilio 1997:31).

gravity, weather and other geophysical properties and processes.²⁰⁹ At the same time, the material movement of this matter must respect the lay of the land and cannot, unless in the air or on sea, move in a straight line. Geophysical processes are for Virilio a break on speed, but therefore constitute elements of capital's spatial barrier as much as the lay of the land; mountains, rivers, valleys, trees and so on are very real obstacles to the friction-free movement of capital. The connection between Virilio's real space and Marx's concept of barrier should now be clear. Marx's spatial barrier should be understood as a combination of the extension, geography and geophysical processes and properties of real space.²¹⁰

Real space corresponds to a particular type of time that Virilio refers to as extensive with a past, present, and future (Virilio and Lotringer 2008:98). Like Winkler, Virilio argues that time is a dependent variable of space; as distance increases so does the time it takes to cover it assuming speed is constant. In Leibnizian terms, time is the order of succession and space that of co-existence, meaning that everything occurring in real space happens at specific moments in time and unique locations in space (Crang 2007:69). As Virilio argues, everything in real space has its unique "here and now," meaning that real space divides and separates rather than connects (1999; 2007:26-9; Breuer 2009:217). Anything and everything that exists or occurs in real space—the supply chain, individual commodities, containers, and vehicles—are structured and can be interpreted according to the intervals of duration (time) and extension (space). That the stages of capital's circuit are "external" means that they exist in real space and are therefore structured according to the intervals of duration and extension. I argue that Virilio's intervals are for all intents and purposes identical to Marx's barriers of space and time precisely because circulation has both extension (space) and duration (time).

²⁰⁹ For example, volcanic eruptions can effectively ground airplanes and close airspaces, and snow storms can lead to blocked roads and stuck vehicles.

²¹⁰ Moreover, even political geography conditions the movement of capital; the matter of capital is subject to the laws of nation-states as much as that of gravity and thermodynamics.

6.2.2.2 The barrier of (circulation) time

Capital's barrier of time in the sphere of circulation has to be qualified specifically as a barrier of circulation time. This barrier is directly related to the extension of space with spatial distance contributing the most to how long capital must circulate. Although this time is also a time that passes, has duration, and can be divided into a past, present, and future, it is a specific capitalist time, and its status as a barrier can be appreciated only when it is contrasted with production time.

As I have stressed several times in this dissertation, in the sphere of circulation capital is posited in its forms (commodity and money) and is valorized in the sphere of production. That capital is a unity of production and circulation means that circulation is as important for capitalist production as production itself (Marx 1978:205). But because it is the production of surplus-value and not its realization that is the purpose of capitalist production, the time that capital circulates is time that cannot be spent extracting surplus-value from living labour. Production time and circulation time are, therefore "mutually exclusive... Capital's circulation time generally restricts its production time, and hence its valorization process. Moreover, it restricts this in proportion to its duration" (Marx 1978:203-4). The duration of circulation is consequently a negative limit on production, and restricts how many times the production process can be repeated and hence how much surplus-value can be created within a given period (Marx 1973:519, 538-9, 621; 1978:203-4).²¹¹ In other words, circulation time is a "deduction from *surplus labour time*" (Marx 1973:539; see also 1978:203). Marx, therefore, argues that: "*Circulation time appears as a barrier to the productivity of labour... a barrier to the self-[valorization] process*" (Marx 1973:539). Even though it exists in the sphere of circulation, circulation time is thus a barrier to capital because it restricts production.

²¹¹ For example, if both production time and circulation time is three months, the production process would occur twice within a year. If circulation time is reduced to one month, which is to say that capital's circulation process is accelerated, the production process could be repeated three times.

Because circulation time is a negative limit on the expansion and contraction of production time and thus on the scale of production, Marx argues that the “more that the circulation time comes to zero, the more the capital functions, and the greater its productivity and self-valorization” (Marx 1978:203). In other words, there is an imperative for capital to increase its velocity as it moves through the sphere of circulation in order to overcome the barrier of circulation time; circulation time is the measure of this velocity which means that the lower circulation time is, the less it appears as a barrier (Marx 1973:518).²¹² As Marx argues, all “that can happen through the acceleration and abbreviation of circulation time—of the circulation process—is the reduction of the barrier posited by the nature of capital” (1973:545). In addition to having a logic of movement, capital also has a logic of acceleration (Manzerolle and Kjösen 2012; 2015). This logic is tied to circulation time being a deduction from production time and from capital trying to avoid idle moments. Marx argues that when capital is stuck in a stage and frozen in a particular form and its (formal) movement is not a fluid transition, capital is negated as capital and devalued as value (Marx 1973:620-1; 1978:123-4, 133, 154; Harvey 2006:85). For capital stasis is death and movement is life, and capital lives the more the faster it moves (Kjösen 2010; Manzerolle and Kjösen 2012; 2015).

6.2.2.3 The dromologic of capital

When Innis referred to space-biased media, he first and foremost thought of light-weight media like paper and papyrus because of their ease of transport. At the same time, he also referred to infrastructure and vehicles as space-biased media; for example, the Persian Empire relied on an “an elaborate administration based on a system of roads and the use of horses to maintain communication by post with the capital” (Innis 2008:15, 40). In other words, for a message to overcome space, it required a combination of infrastructure (e.g. roads and rivers), vehicles (horses, chariots, canoes, boats), and light-weight,

²¹² There are also other reasons and benefits to accelerating capital through the sphere of circulation. The rate of profit and surplus-value is increased by speed through the reduction of costs of circulation (Marx 1973:518; 1978:124, 389; Harvey 1990:229; 2006:85-87; Dyer-Witford 1999:116, 202), and in a given period, a quantity of capital with a high velocity of circulation may create more surplus-value than a larger quantity of capital with a low velocity of circulation (Marx 1973:518-519).

portable media such as paper (Kittler 1996; Innis 2007; 2008). Capital's transfer media consists of and overcome the barriers of space and time with a similar mix of infrastructure and vehicles.²¹³

Capital's transfer media for commodity capital includes first and foremost the totality of the intermodal transportation system as discussed in chapter three: the various standard containers, container ships, trucks, truck chassis, trains, double-stack rail cars, railways, cranes, highways, canals, tunnels, bridges, and canals. The transfer media for money capital that I discussed in chapter five are primarily transmission media and includes VISA's electronic value transfer system as exemplified in their payment terminals and BASE I systems for automated clearing of payments. There are, however, also media for transporting money capital, such as armoured vans. How do moving vehicles and immobile infrastructure in combination overcome the barriers of space and time?

Marx refers to infrastructure, such as roads and canals as "articles of locomotion" and argue that they facilitate or make circulation possible (1973:530). Although Marx does not refer to transportation vehicles as a special category—they belong to the means of communication and transport together with infrastructure—he argues that the general development of the means of communication and transport in terms of their speed and capacity shortens absolutely the period in which they migrate and at the same time abolishes distance relatively (Marx 1978:327-8). For example, after the invention of the steam engine, the time it took to cross the Atlantic was reduced by seven days.

Harvey specifies that capital moves in space through "physical infrastructure that is immobile in space" and other kinds of "fixed capital" that are "free to move in space"

²¹³ The size, shape and weight of the natural forms of commodities and money are, however, no longer salient due to the intermodal transportation system. Although the natural forms of capital do condition the relative ease or difficulty with which they can be transferred (Harvey 2006:376), most commodities, even if heavy and/or large, can be transported in containers and moved by the systemic technologies of capital's intermodal media system for transfer. Based on my discussion from chapter three, only those commodities that weigh more than 26.5 tons and are larger in dimensions than a high cube container (20ft by 8ft by 9ft 6in) cannot be transported by the intermodal transfer medium of capital. Twenty-foot, so-called heavy tested containers are purpose built to transport heavy goods, such as industrial machinery, carrying a net load of up to 28 tons.

(2006:379-80).²¹⁴ More specifically, he argues that the annihilation of space by time require a very specific organization of space that is tantamount to physically adapting the geography of the earth to the interests of capital accumulation. Harvey's analysis of the means of communication and transport is interesting because it moves Marx closer to a dromological explanation of the relationship between infrastructure and vehicles. Virilio's dromology thus takes Harvey's interpretation to its logical conclusion.

Dromology is a neologism and science invented by Virilio for the study of the logic of speed and its impact on human culture and technological systems (Redhead 2004:8; James 2007:29; Ebert 2013:69).²¹⁵ According to Virilio, dromology is "the study and analysis of the increasing speed of transport and communications on the development of land-use" (1996:13). There are thus two components to dromology that need to be addressed: (1) the acceleration of vehicles; and (2) progressive reorganization of the geography of the earth in the interest of acceleration. Dromology thus explains the precise relationship between infrastructure and vehicles, although Virilio refers to them respectively as "large static vehicles" and "small dynamic vehicles" (Virilio 1997:79-81; 2007:83-9). Following the analysis of intermodal transportation in particular, I argue that capital overcomes space and time dromologically. In order to proceed, it is necessary to examine how Virilio discusses the relationship between land use and the acceleration of vehicles.

In *Negative Horizon*, Virilio (2005) argues that up until the industrial revolution, speed was limited by the metabolic human and animal body, and what was provided by nature, such as wind, waves, and rivers. The maximum speed of metabolic bodies is relatively

²¹⁴ While both infrastructure and vehicles are arguably fixed capital, the former is only so if it functions to produce (relative) surplus-value. While roads, railways, airports, container ports, and canals can be privately owned and/or operated, when they are operated by the state alone, they are not fixed capital. Harvey does not, however, make this distinction because he does not have a proper appreciation of Marx's economic forms.

²¹⁵ Although this theory of speed is phenomenological in its foundation and orientation (Redhead 2004; James 2007), treating it as a history and geography of speed instead makes for an easier juxtaposition with Marx (see Kjosen 2010).

low when compared to the speed created by technological motors. The metabolic body is in effect a break on speed; Virilio therefore refers to metabolic societies as an “age of breaks.” This age ends with the “dromocratic revolution” and is replaced by the “age of acceleration,” which starts with the invention of the steam engine and is thus marked by the possibility of producing technological speeds that outstrip metabolic bodies and what nature can provide (Virilio and Lotringer 2008:45; Breuer 2009:223).²¹⁶

Dromocracy is a condition of progressive acceleration. The source of acceleration after the dromocratic revolution is the motor vehicle: after the steam engine, technological speed increases with the invention of other engines, such as the internal combustion engine, the diesel and electrical engine, the jet engine, and the rocket that can reach orbital velocity and break free from the gravity of real space. Technological speed initially produces relative gains in velocity—such as the relative gain in speed of the steamship over the zig-zagging sailing ship that reduced transatlantic voyages by over two weeks—for the purpose of displacing matter as fast as possible from one point to the other. In *Open Sky*, Virilio captures the function and effect of transfer media in shrinking space and eliminating time: “the acceleration of communication tools... obliterate the Atlantic (Concorde), reduce France to a square one and a half hours across (Airbus) or gain time over time with the [*Train à Grande Vitesse*]” (1997:9).

But technological acceleration is not possible without adapting the land in the interest of speed. Real space is a barrier because of the lay of the land, whether it be uneven terrain, the imposition of forests or mountains, or interruption of land by water (and vice versa). Hence, Virilio argues that there are “permanent requirements of organizing and constructing real space—with its land problems [and]... geometric and geographic constraints” (1997:13). Moreover, the purpose of “the building of bridges and roadways,

²¹⁶ Metabolic vehicles are limited in speed due the limited capacity of the physical and chemical processes of these living organisms to make energy available for movement, acceleration, and carrying capacity. For Virilio, the dromocratic revolution is more significant than the industrial revolution, arguing that “there is no industrial revolution, only a dromocratic revolution” out of which emerges dromocracy (2006:46). Dromocracy is the possibility of fusing power and speed to produce artificial speed, and for further progressive acceleration until the cosmological limit speed of light has been reached.

the digging of tunnels, the laying of railways and highways... is to make the territory more dynamic, in order to increase the transit speed of people and goods” (Virilio 1997:79).

In Greek, the word *drómos* (δρόμος) connotes, among other things, race, path, and racetrack. With dromology, Virilio is thus stating that the world is turned into a racetrack for accelerating motor vehicles. I argue, however, that in the race for surplus-value, real space is adapted not merely in the interest of speed, but increasing the velocity of circulating capital or, what is the same, reducing circulation time. I argue that this racetrack is the supply chain I discussed in chapter two. More specifically, the different points of production and exchange are so many start and finishing lines in a racetrack consisting of highways, railways, tunnels, bridges, and stretches of water connected by ports. Following this understanding of dromology, I argue that there is a division of functions between infrastructure and vehicles: whereas *infrastructure binds or bridges space, vehicles in their capacity to move and accelerate actually overcome both space and time.*

Perhaps the best example of capital’s dromologic—changing land-use in the interest of the circulation of capital—is the land-bridge. The standard container effected a fundamental shift in linking “land and sea transport in an almost seamless and profoundly international continuum” (Broeze 2002:5). As Craig Martin argues, by bridging land and sea, the container rendered their conceptual and material opposition into a unified “logistical surface” (2013:1023).²¹⁷ In effect, the unique characteristics of the geography over which containers move are annihilated (Steinberg 2001:165). With the container and intermodal transportation system, including its vehicles and infrastructure, land and sea are transformed into a “single glaxis” that presents “no permanent obstacle to a vehicular movement of planetary dimensions” (Virilio 2006:74, 73; Martin 2013:1024-5). Sea and land blend together in both directions: the seagoing container is seen as an extension of

²¹⁷ Martin argues that the “logistical surface” can be thought of as what Deleuze and Guattari referred to as a striated space, i.e. a space that is constrained by infrastructural mechanisms which organize movement between specific points (2013:1025).

land routes “in a liquid element” and land is viewed as a bridge between the world’s oceans (Klose 2015:103, 110). Another salient example of dromology, albeit more in the interest of capacity, is how the Panama Canal was widened and the Suez Canal deepened in order to accommodate ever-larger container ships.

Overcoming the barrier of real space dromologically “has always been a matter of *the clearing the surface of anything in the way*”, but the real space of geography, is “[n]ever smooth enough, never *desertified* enough, the solid element of the earth’s surface seems... too restricting for transport acceleration” (Virilio 1997:81). Small dynamic vehicles are moved underground, onto water or into the air where physical obstacles are bypassed in favour of linear movements. But even air, wind, water, and waves are obstacles to acceleration. Ultimately, real space and its matter is a speed bump for further acceleration (Breuer 2009:224).

6.2.2.4 Transmission, real-time, and capital’s speed limit(s)

In real space, it is impossible to overcome completely the barrier of circulation time, which can only really be lowered by accelerating capital’s transportation media. Only when capital is transmitted in what Virilio refers to as “real time” and at absolute velocity can the temporal barrier to capital be overcome. The second revolution in technological speed is the microphysical revolution in transmission. In contrast to relative gains in velocity, this revolution enables absolute acceleration up to the cosmological limit speed of light (1997:9). Absolute speed requires different infrastructure; the impact of speed on land-use, therefore, changes from building railways, seaports and, other large-static vehicles to constructing and adapting real space to the “real time of immediacy and ubiquity” (Virilio 1997:13). Consequently, the geographical foundations of real space give way to a “tele-foundation of the global real-time communications system” that consists of fiber optic cables, server farms, and routing equipment that is necessary for facilitating microphysical transmissions (Virilio 2000:9; 1997:84; Blum 2012;

Starosielski 2015).²¹⁸ Microphysical transmissions, in other words, do not occur in the real space of geography but in the “real time” of electronics (Virilio and Lotringer 2008:115).

At absolute speed (60-90% of the speed of light), the earth’s extension is reduced to nothing. Real time is a condition of ubiquity and simultaneity where everything is in electromagnetic proximity because there is no difference between near and far at absolute speed—things do not get up and move from A to B but are rather copied or reproduced. The principle of transmission is therefore simultaneity (Virilio 1991; 1997:13, 19; Winkler 2009a). At absolute speed, the duration and “sequencing of events, where one event needs to happen before the other” is also eliminated (Crang 2007:76), such as the sequence of events of purchase, production, and sale in the circuit of capital. Whereas the time of real space passes and has duration, real time is effectively a negation of time in favour of the simultaneous and present instant.²¹⁹ Real time thus represents the end of geography and temporal succession (Virilio 1997:9, 39).

Capital’s real-time transfer media—broadly telecommunications—abolishes both distance and time absolutely. In real time commodity capital and money capital assume the material form of electronic pulses, which enables capital to reach absolute velocity, i.e. a circulation time of zero. At this speed, the barrier of (circulation) time is not merely overcome, but eliminated. A circulation time of zero is, however, capital’s speed limit (Kjøsen 2010:33). Although capital functions more the faster it can circulate, it cannot reach absolute velocity because a circulation time of zero would be “the same as to suspend the necessity of exchange, of money and of the division of labour resting on

²¹⁸ Real space is not just reorganized, but its geophysical properties, in particular electromagnetism, are also harnessed in the interest of speed.

²¹⁹ Because of phenomenological commitment to the natural human body, Virilio (1997) maintains that time is voided at absolute speed because it is beyond human perception. But as Winkler (2009a) points out, even transfers occurring at absolute speeds takes time. If a message was sent to Jupiter and back, however, even a human being would realize that transmitting something consumes time considering that it would take the message twenty minutes to reach its destination and another twenty minutes to get the reply back (Winkler 2009a:2).

them, hence capital itself” (Marx 1973:629). Capital’s stages cannot be simultaneous because

time must pass between the different metamorphoses through which capital must travel; its circulation time *must* appear as a deduction from its production time... the nature of capital presupposes that it travels through the different phases of circulation not as it does in the mind, where one concept turns into the other at the speed of thought, in no time, but rather as situations which are separate in time. It must spend time as a cocoon before it can take off as a butterfly (Marx 1973:548-49).

I have argued before (Kjøsen 2010) that digital piracy is an effect of capital having broken its speed limit; the result is that part of the valorized capital value leaks from the circuit because the digital use-value escapes the commodity form and therefore cannot be turned into money at absolute velocity. Instead of going to the market, the use-value goes straight into the sphere of consumption (Kjøsen 2010; see also Dyer-Witheford 1999:202).

I am not arguing, however, that it is impossible for capital to circulate in real time without breaking its speed limit. For example, the transfer of monetary value via the VISA payment system occurs in and through real time and allows for near-instant repatriation of money. But more importantly, the continued existence of the iTunes Store, Steam, other similar e-commerce sites, and for that matter streaming services like Netflix and Spotify, are evidence of the profitability of conducting business in real time. Indeed, the potential for profit when producing and selling digital commodities is potentially high because the marginal cost of reproducing/transmitting a digital commodity is low; an infinite number of copies can be made from one digital use-value without any significant loss of data (Kjøsen 2010:71). Selling digital commodities, however, requires the insertion of a brief temporal lag before their reproduction; this temporal lag is the moment of exchange. In real time, commodities do not “go to market and perform exchanges” but are rather transmitted and reproduced after exchange (Kjøsen 2010).²²⁰

²²⁰ The commodity is effectively withheld from and prepared for circulation by being placed in secure servers, added to virtual store fronts, and advertised (Kjøsen 2010; Sussman 2012:483-4). The current apotheosis of capital’s compulsive acceleration in real-time circulation is found in Hibernia Network’s

There are, however, additional speed limits to capital's circulation that arise from the material characteristics and the systemic nature of capital's media. The actual speed a motor vehicle can achieve is one such limit.²²¹ As discussed in chapter three, speed at sea is expensive because fuel consumption of large container ships rises exponentially with their velocity. Although the massive diesel engines that run container ships can sustain up to 25 knots, they are run at super-slow steaming speeds to save fuel costs. The particularities of the motor vehicle and its engine combined with the geopolitics and economics of oil are, therefore, an effective speed limit to capital and contributes to raising the barriers of space and circulation time. There are other phenomena that do not necessarily represent a speed limit, but nevertheless cause capital to decelerate. In chapter three, I also discussed how missing container chassis led to port congestion and delays of up to several days. The lowered speed or missing components do not mean, however, that intermodal transportation is functioning as a fetter on the mode of production. From an engineering and technological perspective, the capacity to steam faster is still there, and the logistics of chassis can be improved.

6.2.2.5 Capacity: acceleration beyond speed

Despite the speed limits, it is possible to accelerate by increasing the capacity rather than the speed of the vehicle. Virilio is cognizant of how increased capacity takes over when

laying of the first new trans-Atlantic fiber-optic cable since 1993. Completed in September 2015, this 4,568 km, 6-pair transatlantic submarine cable system linking Halifax (Nova Scotia) to London and Cork (Ireland) shaved off 6 milliseconds from the previous fastest transmission time of 65 milliseconds between London and New York (Hibernia Networks 2015; Manzerolle and Kjølseth 2015:160-1). For human beings this acceleration is phenomenologically insignificant and the milliseconds saved mean nothing, but for high-frequency trading (HFT) companies, that relies on algorithms and software bots to execute buy and sell orders in milliseconds, a single millisecond saved in circulation time between London and New York can mean a difference of \$100 million to the annual bottom line (Manzerolle and Kjølseth 2015:161).

²²¹ Here Virilio is not helpful due to his too abstract approach to technological motors and general neglect of non-technical factors that may cause deceleration. According to Virilio, "the one variation the motor is capable of [is] *acceleration*" (1995:88). In typical fashion, Virilio never belabours the motor as a concept or discusses any actual motors other than addressing them in lay terms (e.g. the computer motor rather than, say, the CPU *Intel Core i5-4670k*).

no further acceleration is possible. He argues that the capacity revolution (*revolution de l'emport*) is the follow-up to the revolution in rapid transportation and starts as soon as maximum possible speed has been reached (Virilio 2010:9-11). As soon as a motor vehicle or microphysical transmissions have reached top speed, the only thing left to increase is the payload or carrying capacity of the vehicle (Virilio 2010:9-10). The example Virilio uses to illustrate his argument is the massive growth in container ship capacity. As I discussed in chapter three, there has been an almost unchecked growth in container ship capacity since the 1970s; as measured in TEU, capacity has increased from 1-2500 TEU to 19,000 TEU today. And in the 1980s, the capacity of the railroads doubled after the invention of the double-stack railcar. But how can increased capacity accelerate capital? Why is it a type of acceleration?

In *Capital Vol. 2*, Marx argues that “the mass of means of communication develops, so that for instance many ships depart for the same port at the same time... freight ships leave Liverpool for New York, for example, on different successive days of the week” (1978:327-8). The latter development concerns improved schedules, but because they are one of the ways in which capital’s movement is processed I discuss them in the section on capital’s processing media. With the term “mass,” however, Marx is referring to an increase in the number of vessels available for transport, but it can also be interpreted to refer to capacity given that more ships would lead to an overall increase precisely in capacity. While Marx admits that these developments do not directly reduce circulation time, the increased capacity eliminates the need for additional journeys that would otherwise add to the circulation time for the total valorized capital value.²²² In other words, capital accelerates by increasing its bandwidth: while speed may be constant,

²²² Say a valorized capital value (\$1000) is objectified in the equivalent of 200 TEU. If one ship with 100 TEU took two weeks to steam from London to New York and back, it would take a total of four weeks of circulation time before the entire capital value was realized (assuming that the commodities are sold as soon as they reach New York). If an additional 100 TEU ships were added to the route and left at the same time, or a single ship with a capacity of 200 TEU served the route, the circulation time would only be two weeks.

more is transported at the same time.²²³ Indeed, in response to lowered speeds, container ship lines have added additional vessels to routes so that the added capacity and more regular schedule compensates in part for slower steaming.

6.2.3 Storage

Of the three media functions, storage poses the greatest conceptual problem in modifying it into a function that is expressed in the category of capital's storage media. In media theory, the function of storage or time-biased media is to overcome time. But as I have already discussed, the barrier of time is overcome by capital's transfer media. Also, it is important to recall that Parker correctly observes that the storage of material goods is a translation through time (1981:130). Storing commodities, therefore, adds to circulation time rather than overcoming it. Capital's storage media do, however, overcome one of capital's barriers in circulation. Nevertheless, storage, as understood by media theory as something that lasts through time and having connotations of durability, does have its equivalent in capital's media. To proceed it is necessary to discuss media theory's storage function so that I can clarify what barrier capital's storage media overcomes and what case studies from part two appear in this particular sub-category of capital's media.

Prior to the emergence of technological media (e.g. gramophone and film), it was impossible to record a temporal event, such as speech or music, in its flow; once the event was over, it would be lost to time forever. Until the advent of technological media, the only possible type of cultural storage was human memory, writing, or art (Kittler 2010; Peters 2010:13-4). But with analog media, it became possible to record events that move within the flow of time by inscribing sound and light onto a surface. The function

²²³ Given that both trains and container ships typically run set routes, it would be possible to determine the approximate bandwidth for capital between two points, such as between ports or continents. Capital's bandwidth could be calculated with the ratio TEU/knots (or TEU/kmph). Such an analysis would likely show that the East-West routes between Asia, Europe, and North America have a considerably larger bandwidth than the North-South routes leading to South America and in particular Africa, which is only sparsely covered by the container system (UNCTAD 2014; Klose 2015:300). With the construction of new and larger container ships, however, bandwidth increases on nearly all routes as smaller ships are moved to service less busy routes (UNCTAD 2014).

of storage is thus tied to a notion of stasis; what is recorded becomes fixed as if it is frozen in time.

Winkler argues that storage should be understood as a spatialization of time. For example, oral expressions produce a temporal stream of signs and thus operate successively; writing transforms this successive existence into a spatial co-existence on an inscription surface (Winkler 2009a:2). For example, alphabets project a temporal event like speech onto a plane, which is a principle that holds for acoustic and optical data streams as well; points in time are assigned to points on a spatial surface such as a compact or magnetic disk (Winkler 2009a:2; Ernst 2013:133).²²⁴ Recording enables retrieval. What occurs with saved acoustic or optical events, however, is that the temporal event, because it was spatialized, can, as Ernst (2013:58) argues, be retrieved as a live presence in the present. The recorded voice of person long dead is not merely a phenomenon of the past; when played back there is a temporal short-circuiting, a Benjaminian folding of time, between past and present so that the dead person's voice actually exists here and now. As the example of pyramids demonstrate, albeit in relation to writing, the more durable the storage medium, the potential for retrieval can span millennia.

What is the storage function of capital's media? And what has duration got to do with this function? The permanence and orientation towards eternity implied by media theory's concept of storage are anathemas to capital given that it is not a static thing; commodities in permanent storage or for that matter a permanent hoard of money is tantamount to capital's negation. Nevertheless, media theory's focus on persistence and duration is salient for identifying the storage function of capital's media and the particular barrier it overcomes. But before I turn to this barrier, I first comment on an implication of storage that is shared by both media theory's and capital's storage media.

²²⁴ When Eadward Muybridge captured a trotting horse as a series of time-lapsed images, he effectively stopped time by freezing motion.

That storing material goods consumes time rather than overcomes it does not mean that it is disqualified as a moment and function of the circulation process. It is a vital function in the material mediation of capital's formal movement. For both Foucault (1994) and Ernst (2013), the archive with its documents and files, irrespective of being static or in motion, is a condition for discourse and making statements. As discussed in chapter four, the old warehouse, or for that matter the larger section of a Walmart regional general merchandise distribution center in which stocks of commodities are held, serves a similar function in being a condition of circulation. That storage is a condition of circulation can consequently be understood as storage enabling retrieval. As mentioned above, recording cultural knowledge or a data stream into an inscription surface allows for their later retrieval or playback at a later point in time. Placing commodities in storage by assigning them a pick location also enables later retrieval, i.e. when a commodity is "picked" for the purposes of fulfilling an order. Of course, the historical short-circuiting type of retrieval that is possible when stored temporal events are played back is not possible with material goods like action figures and food. Moreover, given the passage of time, use-values lacking durability may leave nothing at all to retrieve, such as when foods rot and perish.

6.2.3.1 The barrier of use-value (perishability)

The barrier that capital's storage media overcomes is use-value. As mentioned in the section on particular functions, there are two barriers of use-value. The one I have already described, albeit briefly, refers to how need for a particular use-value is either limited or has been satisfied (in the next section, I show how this particular barrier is overcome by capital's processing media). In *Capital Vol. 2*, Marx argues that use-value is a barrier for an additional reason. To understand what this barrier is, we first have to recall that use-value is the material bearer of exchange-value. Due to this relationship, the

very form of existence of commodities, their existence as use-values, sets certain [barriers (*Schranken*)] to the circulation of the commodity capital C'—M'. If they do not enter into productive or individual consumption within a *certain interval of time, according to their particular characteristics, in other words if they are not sold within a definite time, then they get spoiled, and lose, together with their use-value, the property of being bearers of exchange-value*. Both the capital value contained in

them and the surplus-value added are lost” (Marx 1978:206, emphasis added).²²⁵

If the use-value perishes, the commodity cannot be sold and the surplus-value objectified in it likewise cannot be realized. The result is that surplus-value leaks from the circuit of capital. The same is the case if the commodity was digitally pirated, stolen, lost, broken, or damaged before it reaches the point of exchange; whether a container full of tomatoes rots, falls overboard, or is stolen while the fruits are still red and juicy, the effect is the same; a loss of surplus-value. The technique that corresponds to capital’s storage media is therefore not recording, but rather protection, preservation, and even precaution. And the barrier capital’s storage media overcomes is the use-value’s perishability and risk of damage or theft.

If capital’s storage media could speak, they would recite a slogan that is close to that of the police: “our function is ‘to preserve and protect’ the use-value because it is a bearer of exchange-value.” Capital’s storage media thus concerns the “conservation of the value which exists in the commodity as a product [that]... can be conserved only by conserving the product, the use-value itself” (Marx 1978:217). Put differently, the storage function keeps the commodity, or for that matter money, in its form until it is ready to perform exchanges. I now turn to discuss what things from part two appear in this particular category and how precisely they overcome the barrier of use-value (perishability).

6.2.3.2 To preserve...

With the focus on preservation and protection, capital’s storage media are versions of what Zoe Sofia (2000) calls “container technologies.”²²⁶ According to Sofia, container

²²⁵ David Fernbach’s translation of *Schranken* as “limits” is not consistent with Martin Nicolaus’ translation of *Schranke* from *Grundrisse* as “barrier”. While both translations are technically correct, they may appear to be different to an English speaker.

²²⁶ Sofia developed this concept based on her critique of Western philosophy’s valorization of tools as masculine and active, and its notion of space as female, passive, and unintelligent. With the concept of container technology, Sofia reconfigured containment as an (inter)active process of holding and supply (2000:181).

technology, or rather containment, can be viewed as a corrective to philosophy's focus on tools, such as the spear and hammer, and McLuhan's notion of extensions. Whereas tools connect to the body, are things that reach out, and emphasize "speed, motion and extension," containers in contrast "keep and preserve their contents over time and act as a technology of re-sourcing and storage" (Lebel 2015:3; see also Sofia 2000:192). The two types of technologies are thus connected to particular temporal characteristics, namely speed in the case of tools and duration in the case of containers (Sofia 2000; Lebel 2015:4).²²⁷

Lewis Mumford, whose analysis of containers Sofia both drew on and critiqued, argued that a container's role is enlarged by the "life arresting processes of sterilization and preservation" (1966:140-1). That food eventually spoils and rots has been common knowledge for millennia and attempts at preventing or slowing down this type of entropy has been ongoing. Ancient techniques of preservation include drying, salting, smoking, fermenting, and pickling (Shepard 2000). The revolution in preservation did not occur, however, until the nineteenth century when Louis Pasteur published his paper on microorganisms in 1861 and scientifically explained that it is because of the millions of microorganisms that exist in water, air, and the soil that something begins to deteriorate as soon as it has been slaughtered or plucked from stalk, branch, or soil (Shepard 2000:25, 218, 222).²²⁸

The material characteristics of the use-value are thus important because they "decay at different speeds" (Marx 1978:206). While many different kinds of microorganisms contribute to food's decomposition, most of them require a "warm, moist environment held on the slightly acid side of neutral and a supply of oxygen" (Shepard 2000:26). The

²²⁷ Sofia's understanding of tools thus comes close to what media theory refer to as transfer media.

²²⁸ It was not until after the emergence of the capitalist mode of production that food preservation was pursued on a scientific and technological basis. When it comes to preservation, capital's storage media refers only to modern techniques of preservation as opposed to pre-capitalist ones. According to Sue Shepard, canned food "relegated most traditional food preserving to quaint practices of undeveloped regions" (2000:255).

goal of preservation techniques is to remove these conditions so that the microorganisms already in the food are destroyed or their activity is inhibited. A container or package is necessary to prevent the offending microorganisms from re-entering the food after it has been preserved, although in some cases like the tin can, the food is preserved after being placed in a container (Shepard 2000:26).²²⁹ Whereas heating kills microorganisms, freezing and refrigeration preserves them by placing them in a state of limbo until the organic matter they inhabit is defrosted or warmed up (Shepard 2000:281).²³⁰ Today dehydration and in particular freeze drying is one of the most common preservation methods, while food irradiation (using gamma rays) is one of the latest methods (Shepard 2000).²³¹

The speed of decay and efforts in slowing this process down, is significant because there may be a greater or lesser interval of time between a use-value's production and exchange, which in turn means they must

persist for a shorter or longer time in the circulation phase *C—M* as commodity capital, endure a shorter or longer circulation time as commodities. *The limitation of the circulation time of commodity capital imposed by the spoiling of the commodity body itself is the absolute limit of this part of the circulation time*, or of the time for which the commodity capital can circulate as commodity capital (Marx 1978:206, emphasis added).

²²⁹ For example, Pasteur demonstrated that liquids could be safely preserved by being heated in sealed containers to 60°C and keeping them at this temperature for thirty to forty minutes (Shepard 2000:218).

²³⁰ Microorganisms in general do not like the cold because it slows down their metabolism, makes them sluggish, unable to reproduce and keep on with their putrefying activities.

²³¹ It is curious that Marx does not mention modern methods for preserving food (or other commodities) in *Capital* considering he did discuss the relative perishability of use-values. Given that the first commercial canning business opened in 1810, three years before his birth, it is quite possible that Marx did at least know about this technique for preservation and about pasteurization in general. And considering that the American Civil War (1861–65) created the first major American demand for canned foods and that both Marx and Engels covered this war, they would arguably have been aware that provisions of troops on both sides consisted in large part of canned foods. It is, however, less likely that Marx was aware of preservation techniques like mechanical freezing because it was only towards the end of his life that many of the breakthroughs occurred. In order to find out whether Marx wrote about any preservation techniques, the *Marx-Engels Collected Works* will have to be consulted.

Storage in combination with the technique of preservation refers to the shelf life or rather the “circulation lifetime” of the use-value, which must endure until the commodity is sold (and not returned).²³² As Marx writes, the more perishable a commodity is, “the greater are the absolute [limits (*Grenze*)] to its circulation time that its physical properties impose”, which, according to Marx makes it more or less “appropriate... as an object of capitalist production” (Marx 1978:206).²³³ It is in combination with freezing, refrigeration, pasteurization, and other preservation techniques that capital’s storage media extend the circulation lifetime of the commodity and with it, its spatial orbit.

A commodity has a limited or an absolute circulation lifetime, which means that it can endure circulation for a longer or a shorter time. This lifetime also limits the spatial orbit of the commodity’s circulation; commodities that cannot endure long circulation times will circulate in local markets. Marx, therefore, argues that capitalism can deal in perishable commodities only in areas with high population density or with developed means of communication (1978:206).²³⁴ While fast transfer media can widen the spatial orbit of a particular commodity relatively, capital’s storage media can widen this orbit absolutely by extending the absolute circulation lifetime of the use-value. With various

²³² While similar, the absolute circulation time of a commodity should not be directly identified with shelf life because while the latter does refer to the length of time a product can be stored until it becomes unfit for sale, it can also refer to it becoming unfit for use or consumption, which, unless this causes the use-value to be returned (and hence subject to a reverse logistics process), is of no consequence to capital. All that matters for capital is that the valorized capital value is realized. Formally, capital can reproduce itself without (individual) consumption as long as there is circulation. Hence, as a concept ‘absolute circulation time’ is almost equivalent to the ‘sell by’ or ‘display until’ date. I write almost because if not for such regulations, capital would not cease trying to shed its commodity form until its bearer has perished.

²³³ Fernbach’s translation of *Grenze* as “barrier” is incorrect; the word should be translated as “border” or “threshold”. The confusion is compounded by Nicolaus translating it as “limit” in *Grundrisse*.

²³⁴ As I mentioned in chapter two Marx considers a region with well-developed means of communication and transport has a higher population density than a region with a similar or even larger population but with less developed means of communication. In effect, population density refers to the capacity and diversity of connections a population has relative to its media systems. Amazon Fresh (n.d.) and other fresh food delivery services respond to the barriers posed to circulation by perishability by limiting their operations to major cities with concentrated populations and where the communicative infrastructure allows, for example, Seattle, Los Angeles, and New York.

types of packaging, preservation, and containment, even the most perishable of commodities, like fish, can be transported from the coasts of Namibia and Peru, and still be sold as fresh in Spain (Sheffi 2012:8-17).²³⁵

Of the objects discussed in part two, the refrigerated container (“reefer”) and the perishable grocery distribution center are the best examples of storage media that preserve. Reefers are used to transport things that are temperature sensitive, possible because they are equipped with or hooked up to sensors and computerized controls capable of regulating air humidity and temperatures ranging from -65C to 40C. Even perishables distribution centers that operate as cross-docking facilities and, as such, function as processing media (see below), also function as capital’s storage media due to regulating their climates to arrest the entropy of the commodities that pass through them. These storage media put their contents in a kind of deep sleep and/or maintain an optimal climate for whatever the contents may be. In the case of freezing, it is as if the use-value is placed in stasis—almost like a temporal data stream being frozen in time—because freezing puts microorganisms that are the cause of decay in hibernation. Deep-frozen foods are effectively ripped out of their own time of decay, placed into the space-time of the container or package, and re-enter their own time when they are emptied out of the reefer or package.²³⁶

²³⁵ A historical example of how capital’s storage media overcomes the barrier of perishability comes from early nineteenth century Australia and South America. Being producers of meat in large quantities, but being far away from important food markets and with no way of preserving their meat at the time, exporting was impossible. At the time capital’s storage media were not yet adequate to the mode of production (Shepard 2000:148-9). But after the *SS Strathleven*, equipped with a steam-powered air compression refrigeration, made the two-month journey from Sydney and arrived in London February 2, 1879 with forty tons of frozen beef and mutton in excellent condition; Australian meat could now be sold on the world market because the circulation life time and spatial orbit of the meat commodity had been extended (Shepard 2000:299-300).

²³⁶ Another good example of capital’s storage media combined with “life arresting” aspects is modified atmosphere packaging (MAP). First developed in the 1940s to slow the ripening of fruit, MAP refers to a technique of sealing fresh fruit, vegetables, or meat in polymeric film packages to modify the carbon dioxide, oxygen, and nitrogen levels within the package’s atmosphere. Thus MAP operates on the basis of chemically changing the air surrounding the food to another composition. An atmosphere high in CO₂ or low in O₂ influences the metabolism of the packaged product or the activity of the microorganisms that cause decay with the effect of increasing the shelf life of the product or having it ripen at the right time. MAP also improves moisture retention, which in some cases contributes more to preserving the product

6.2.3.3 ...and protect

In *Capital Vol. 2*, Marx argues that depending on the size, weight, perishability, fragility or explosiveness of the commodity, different “measures of precaution” must be taken during the transportation, warehousing, or display of the commodity (1978:228). In addition, the commodity must be protected from both theft and the elements, which requires “buildings, stores, containers, warehouses [, etc.]” (Marx 1978:215). Along with preservation, these measures for precaution and protection comprise the functions of capital’s storage media, although the difference is that precaution and protection cannot extend the circulation lifetime of the commodity.

The standard container and packaging are the best examples from those discussed in part two, of storage media which protects. A primary role of packaging is to protect its contents and make shipments safer so that people can buy and consume the contents even if it was produced far away and a while ago (Hine 1995:3, 43, 57; Shepard 2000:16; Saghir 2004). All types of containers and packaging, such as cardboard boxes and tin cans, function as capital’s storage media by being a physical barrier between the commodity and the outside world, thus providing use-values with a protective shell and milieu.²³⁷ By enclosing and sealing the use-value in a container, it is “subject to the time-space condition of the box” (Klose 2015:19).

Containers and packaging isolate the use-value from the external environment and help maintain conditions which reduce exposure to the elements, pathogens, and pests, thus

than modifying the CO₂ and O₂ levels. Particular foods have specific “respiration needs” that can be tailored by MAP (Mir and Beaudry 2004).

²³⁷ The most common packages are paper bags, cardboard boxes, cans, metal tubes, modified atmosphere packaging, aseptic packaging, cellophane, plastic containers, and more (Hine 1995; Shepard 2000). Of these, the folding cardboard box is the most used package worldwide today, while the brown paper bag played a significant role in selling and transporting commodities in the 20th century (Hine 1995:57). Whereas all packaging is designed to preserve and protect, primary consumer packaging is also designed to sell. Consumer packaging is referred to as the “silent salesman” and is designed to “move... goods quickly” (Hine 1995:18, 22; Klimchuck and Krasovec 2012:4).

ensuring that its circulation lifetime is not cut short. For example, while standard containers at sea are subject to rain, the dehydrating and bleaching effects of the sun, and the corrosiveness of salt water, its contents are not. Placing commodities in a standard container or packaging thus limit the duration for when they are subject to abuse (Hine 1995:71). After use of the standard container had matured in international shipping, claims of damage to goods in transit fell by up to 95 percent (Levinson 2006:254). The cardboard box is another example of protective media and next to the standard container; it is the most used type of packaging today (Hine 1995:61; Klose 2015).²³⁸ The reasons for the cardboard box's popularity, and why it is an effective storage medium for capital, are partly derived from its material characteristics. Compared to other types of packaging, such as bags, it is less likely to rupture and spill its contents during transportation, less likely to be crushed, is more suited for printing (e.g. barcodes), and can stand straight (Hine 1995:61-3).

Some types of containers, but in particular the standard container and the distribution center as a structure, also protect against theft and pilferage. In the breakbulk era, theft was an endemic problem because during the weeks-long discharge and loading of ships, individual pieces of cargo were "stored" openly on the docks and were consequently easy to steal. With the growth in trade of higher-value commodities after World War II, theft reached "epidemic proportions" (Levinson 2006:27). In order to avoid or reduce pilferage, commodities were often placed in large, custom-made wooden crates that were awkward to move without equipment. The standard container eliminated the need for such crates and by being the only object of the unloading and loading process, there was simply no individual pieces of cargo left on the docks to steal. As a result of the standard container, theft of cargo dropped sharply (Levinson 2006:254). While container ships are typically conceived as tool technology given their massive engines and ability to cross oceans, Sabine Lebel argues they are also container technology considering they have the

²³⁸ Cardboard packaging accounts for about 45 percent of the value of all packaging used (Hine 1995:63). I recognize that this percentage may be smaller or higher since Hine researched and published *The Total Package*, but I have not been able to find any updated statistics.

“ability to stack massive numbers of containers and keep those shipments safe from elements, spoilage, and piracy” (2015:4). If a cargo vessel were retrofitted with weaponry to fight off maritime pirates, this characteristic would make the container ship function as a protective storage medium.

There are, however, other technologies that protect from theft and should, therefore, be considered as functioning as a storage medium for capital. These include tamper-proof barcodes, anti-theft tags (e.g. placed on clothing or inside books), and sensors that are part of a wider electronic article surveillance system; safes and armoured vans for storing and transporting money capital; and the fraud control built into VISA’s BASE I system. Even digital rights management (DRM) and trusted systems like Xbox or PlayStation function as storage media by encrypting content or making it difficult to access, install, or play back the content unless it has been purchased legally (see Gillespie 2007). Although DRM as a technology failed, in combination with trusted systems it ensures that the commodity is kept in its form even if it is copied without authorization, because DRM effectively turns the use-value into a point of exchange. Capital’s storage media protects against both digital and maritime pirates.

The final functioning of capital’s storage media is related to what Marx (1978:228) referred to as the measures of precaution that must be taken in order to transport fragile things like glass or explosive articles safely. These measures often take the form of packaging. There are broadly three types of packaging: primary, secondary, and tertiary (Saghir 2004). Whereas primary packaging refers to consumer packaging, secondary and tertiary refers to packaging that is structurally stronger and used as measures of precaution for the purposes of transportation, storage, and/or processing purposes. Whereas secondary packaging contains a number of primary packages, tertiary packaging, which includes the standard container and pallets, contains a number of primary or secondary packages. Packaging is thus part of a system that links production, distribution, and consumption. (Hine 1995:14; Saghir 2004:7). The packages that a distribution center processes are examples of secondary packaging that must be sturdy enough to survive being handled by the facility’s automated conveyors. In chapter three, the most important measures of precaution I discussed were the standard container’s

corner fittings and twist locks, the container ship's cell guides, but arguably also truck chassis and the double-stack railcar. Without these different pieces of standardized technology, containers cannot be stacked securely on each other or secured to the particular mode of transportation thus risking the loss of containers and with it whatever surplus-value was objectified in the cargo.²³⁹

6.2.4 Processing

Whereas media theory explains transfer and storage in terms of overcoming space and time, it does not refer to processing as overcoming something. And while transfer and storage have been subject to extensive research in media studies and have stable definitions, processing is the “neglected media function” and has been subject to far less critical inquiries than the two other functions, despite being a fundamental concept in media studies (Winkler 2009a:15; 2009b:1). Kittler was the first to define processing as a media function, observing that computers process data in addition to transmitting and storing it. The question to answer now is: what barriers in circulation does the function of processing overcome? I argue that capital's media of processing do overcome something, namely the barrier of use-value (need). Despite lacking a stable definition of the function, it is helpful to consider how media theory has discussed processing, in particular Kittler's (1999) concept of time-axis manipulation and Winkler's (2009b) exploration of different notions of processing.

As previously discussed, by recording a temporal event into a storage medium, it is spatialized; the dimension of time is projected onto a spatial axis by assigning points in time to points on a spatial surface, such as celluloid film or magnetic disks. Sybille Krämer argues that the flow of time is irreversible is the most basic experience in human existence, but with technological media, time becomes reversible as long as the time axis has been projected onto a spatial axis (2006:96). What is remarkable from a media

²³⁹ Despite these measures of precaution, containers regularly go overboard. Although shipping lines and insurance companies do not publicize any statistics, oceanographers have estimated that colliding with a container on the ocean is as likely as colliding with a sleeping whale (Klose 2015:26).

historical perspective about the technical conversion of time into space is that it allows for time-axis manipulation, i.e. time becomes merely another variable that can be manipulated (Kittler 1999:3, 34-5; Krämer 2006; Peters 2010:11).²⁴⁰ Storage media thus enables the processing—editing and manipulation—of the flow of time with technological means and through techniques such as increasing playback speed, slow-motion, time-lapse, jump-cuts, and so on (Kittler 1999:34-5, 119; Peters 2010:6, 14).

The time-axis of material objects like coffee makers and compact discs in their jewel cases cannot be manipulated like a serial data stream. The concept of manipulation can, however, be applied to understand how capital's processing media materially mediate the formal movement of these objects as commodity capital. This application, however, first requires an exploration of the various notions of processing.

With reference to computing, processing as manipulation refers to the transformation of data—changing inputs into qualitatively different outputs. In this sense, processing concerns “*change*...if it is entailed that input and output are actually different” (Winkler 2009b:3). In terms of change, Winkler argues that processing refers to an operation or practice that may as well be referred to as production—even work—because it refers to the “active intervention in the material, the shaping and transformation of which culminates in the final product” (Winkler 2009b:3). Given that this dissertation is concerned with circulation, it would be a contradiction in terms if production is expressed in the category of capital's processing media. Nevertheless, it is helpful to hold on to the connotation of change. But if not in the material characteristics of an object, then what kind of change should we be considering here?

Drawing on John Durham Peters, Winkler suggests that the function of processing can be referred to as logistical (2009b:7). Instead of processing media, Peters (2013) prefers “logistical media,” which he derived from Innis' focus on how civilizations organize space and time. He argues that in addition to transmitting and recording, media also

²⁴⁰ Time-axis manipulation refers to “a different reordering of a serial data stream” (Krämer 2006:182f).

organize, which is the function of such media. As examples of logistical media, Peters refers to calendars, clocks, and towers because they establish “the basic coordinates of time and space”, “the central points around which culture rotates”, and importantly “arrange people and property into time and space” (2013:41). These media are “prior to and form the grid in which messages are sent” (Peters 2013:41). Towers, for example, can easily be seen from a distance and are, therefore, points of orientation, and means with which people can locate and therefore organize themselves in space. A tower is typically also a central point in a town or village, from where time is kept and or broadcast (e.g. by a muezzin’s call to prayer) (Peters 2013).

Winkler argues for broadening Peters’ concept to refer to “media’s general function to organize the world” (2009b:7). But what does organizing the world mean with reference to capital’s media? And how is this organization a type of manipulation? In order to continue, it is helpful to consider yet another notion of processing that Winkler explores, namely that of addressing and forwarding, which is systematically connected to the two other media functions. Winkler argues that transfer

require[s] multifarious kinds of “processing” to take place at the nodes of the network; consider, for example, the distribution of letters at a central post office, a switchboard or an Internet hub: Every single delivery implies certain acts to take place, such as decision-making, addressing, reordering—in short, “logistics” in the more direct sense of the word (2009b:11).

Processing as logistics is thus a type of switching or routing that occurs at the nodes of a network, such as a supply chain. This type of processing is fundamentally different from modification or qualitative change of matter or signs because “switching and forwarding processes at an exchange point keep the forwarded products intact” (Winkler 2009b:12). Processing thus refers to a particular translation of the original Latin *processus* as progression and course, which in turn refers to the route or direction followed by a road or truck. And as such, processing can be understood as a manipulation of capital’s movement in the sense of giving or changing its direction.

Winkler argues that when it comes to processing as switching/forwarding, the key concept is the address; without it, an object—irrespective of it being a data stream or a

material use-value—cannot be forwarded (2009b:13). With reference to three different media, Winkler writes:

If I am editing a movie... it is up to me to decide on the point in the movie, the physical location, to which a particular sequence is to be moved. If I am forwarding/processing a letter, the address is a far-away, geographical place. If I am saving a file, I am interested in the location in which it is precisely and physically stored (2009b:13).

Curiously, given that he also considers this function to refer to logistics, Winkler argues that what he has illustrated applies only to syntactic operations. I argue, however, that the notion of processing as switching, forwarding, or addressing is perfectly compatible with capital's media that deal with material goods and commodities. Indeed, this is what occurs at specific nodes in the network, such as maritime and inland container terminals, distribution centers, and even the point of sale in a retail store. Indeed, Klose (2015:112) refers to container terminals at ports, rail yards, and distribution centers as “intermodal container switches” for changing modes of transportation and, as I argue, direction. With reference to capital's media, processing, therefore, refers to the technique of materials handling.

Although materials handling in ports and distribution center involves the movement of containers and packages, this movement is not about changing the spatial location of things, but rather about assigning an address, i.e. moving things to a particular position or location in the supply chain, a pick location in a storage facility, or even on a retail shelf. Importantly, this addressing is prior to the actual movement of the object to that location. As I argued in chapter four, if the respective inputs of container terminals and distribution centers are standard containers and packages, their outputs are these same containers and boxes with a new direction and address. In other words, what is manipulated is the position or location of capital and the direction (or vector) of capital's movement. This manipulation of position and movement is the concern of business logistics.

6.2.4.1 Processing as logistics?

Various logistic and supply chain management experts and scholars understand logistics in terms that are almost identical to that of Peters and how Winkler arrives at processing

as addressing and forwarding. Even though I have already discussed logistics in both chapter two and the introduction to part two, it is necessary to revisit some of this terrain to understand better the processing function as applied to capital's media.

Alan Branch argues that logistics is the “time-related positioning of resources” for the purpose of making sure that things, people, and information are in “the right place, at the right time, [and] in the right quantity” (2009:1).²⁴¹ Logistics thus concerns the work or activity of moving and geographically positioning inventory, i.e. scheduling production, storage, and transportation (Levinson 2006:266; Bowersocks et. al. 2012:4). This positioning is, however, about timing because the modern principle of logistics is “the dissolution of a transport paradigm that revolves primarily around the overcoming of *space* in favor of a paradigm in which the control of and coordination of *timing* is at the forefront” (Klose 2015:170). This timing is, in turn, dependent on information for controlling the movement and positioning of capital. The Logistical Worlds project's definition of logistics is not only apt but also comes close to Peters' understanding of logistical media: “Logistics arranges objects in space and time according to the demands of capital” (Logistical Worlds 2014:59).

The precise location or position of something is not accidental, but a key logistics activity. In the chapters in part two, I discussed several examples of how commodities are positioned, typically with the help of real-time telecommunications and computers. For example, where standard containers are stowed on a ship is determined in advance and is dependent on variables such as the weight of the container, when or where it will be unloaded, if it needs external power (reefers), and so on. Retailers like Walmart strategically position inventory so that all high-velocity commodities are located in distribution centers close to where these commodities are sold or close to the distribution centers that cross-dock them. Within distribution centers where commodities are stored for a longer time, commodities with higher velocities are positioned in pick locations that

²⁴¹ Marx did not have a concept for logistics; the closest he comes to addressing the addressing or forwarding of capital is book-keeping, writing that it is by “way of book-keeping [that]...the movement of capital is registered and controlled” (1978:211).

allow for rapid retrieval. Within retail stores, commodities that sell in large volumes are often positioned at locations, such as the back of the store or in the middle of an aisle, to force the customer to walk past as many other commodities as possible in order to induce additional purchases.

The positioning or organizing of objects in time and space does not only refer to commodities. As I discussed in chapter two, Cowen argues that the logistics revolution concerned a new calculation of economic space based on the logic of total cost. This calculation changed the logic of where to locate production and distribution facilities relative to each other and the market. These locations should be understood as so many possible addresses to which commodity capital can be sent. In this understanding logistics, as Peters argues, concerns establishing the grid in which things, people, and information are organized and move. The best example of how things are arranged in space and time based on the logic of total cost is Walmart's network of distribution centers that are used to fortify and saturate geographically bounded markets. As discussed in chapter four, Walmart calculates the locations of their distribution network (including retail stores) in miles, minutes, sales, and costs. Their various distribution centers are located strategically in relation to other distribution centers, retail stores, and the existing transportation infrastructure so that Walmart's fleet of trucks travel the least distance in the aggregate to maximize regional sales.

The need for capital's processing media should be understood as an effect of the logistics or just-in-time imperative of continuous flow. Things are more likely to be in movement rather than standing still. But with this increased movement, control and tracking of movement becomes necessary. As Virilio relates: "According to specialists in logistics...*'the more movement increases, the more control increases'*" (Virilio 1997:127). In general, the higher volume of transport and the higher the speed of transfer, the more control and tracking become important. Klose concurs and argues that an increase in "spatial freedom of movement and flexibility" must be paired with an "intensification of the control of movement" (2015:107).

Controlling capital's movement relies on information about where a particular commodity, container, truck, or shipment is at any point in time. Logistics experts discuss the importance of gaining "visibility" of the supply chain; ideally, it is a "glass pipeline" that reveals where any and all SKUs are at any time (Bonacich and Wilson 2008:37).²⁴² In other words, capital's movement is tracked and registered, which in turn enables the processing of this movement in the sense of addressing or forwarding particular commodities. The tracking and registering of capital's movement primarily occurs at the various nodes of the supply chain and in and through Virilian real time. In chapter five, I discussed how retailers collect torrents of data at the point of sale through the scanning of barcodes; the information about what, when, and where of how particular commodities are exchanged is mined and used as corrective feedback to make decisions about whether a commodity should be held back at its current position or forwarded to another so that it is ready for exchange at the right time and place, and in the correct quantity.

Tracking and collecting information about inventory also occurs at what Florian Sprenger (2013) calls "docking infrastructures," which includes warehouses, distribution centers, and various ports (maritime, air, and tele). Sprenger argues that because all traffic—freight as well as passengers—must at one time or another pass through a dock, "they are one of the few places to observe and inscribe what circulates" (2013:52). This collection of information, which occurs through automatically scanning bar-coded boxes and containers, is necessary to position commodities (or SKUs) within the distribution center or to forward it to another position in the supply chain. As Sprenger explains, to "have objects available, the docking operators need information to monitor their position. The position of every object has to be recorded constantly in order to be available at any given time" (2013:51). Importantly, he ties this information collection function and the increased importance of docks to the waning of the old warehouse: "they gain more

²⁴² This glass pipeline would become a reality with the Internet of Things (IoT). The IoT would, in essence, consist of everyday objects (e.g. fridges, drills, and milk cartons) being equipped with RFID chips. Dependent on the adoption of IPv6, with the internet of things it would be possible to look up in real-time where a given thing is located in time and space. At the moment, however, the IoT is still in its infancy due to both RFID chips and the switch to IPv6 is too costly. Only a few countries, like the Netherlands, have started to build the necessary real-time infrastructure for the IoT.

influence as a site of passage due to new technologies of distribution and tracking” (Sprenger 2013:52).²⁴³ By recording and tracking the movement of their commodity capital through the distribution center network as well as collecting POS-data, Walmart has developed a “predictive technology.” Its media system is thus able to “automatically predict and enable a preventive intervention against any aberration to the hyper-efficient functioning of Wal-Mart’s global supply chains and retail ecologies” (Haiven and Stoneman 2009:12).

Collecting information at the point of sale and at various docking infrastructures (nodes) in the supply chain is not, however, sufficient on its own for controlling the movement of commodity capital. Klose argues that with everything being in motion due to the logistics imperative of flow, “the clock... relentlessly [drives] compliance with the timetable” (2015:296). Whereas collecting information at the POS, in distribution centers, and other docks reveal where commodity capital is located and thus organized in space, it is the timetable or schedule in combination with the clock that organizes things in time. Indeed, time is the primary variable when it comes to processing capital’s movement. As I discussed in the section on transfer, capital has a dromologic of acceleration due to the imperative of overcoming the barrier of circulation time.

But does dromology really capture the logic of capital’s movement? The motor is only capable of acceleration, but speed is not necessarily beneficial to capital. As Bernes argues, manufacturers and retailers must coordinate with both upstream suppliers and downstream buyers and for that “*speed alone is insufficient. Timing is crucial*” (2013:n.p., emphasis added). After all, if a truck races as fast as possible to deliver a shipment to a distribution center or retail store, but comes hours before anyone is ready to unload it, nothing is gained in terms of reduced circulation times.

²⁴³ The current construction boom of networked distribution centers in North America can be explained as a desire by retailers and manufacturers to gain better visibility (Egan 2014). Amazon’s recent construction of “sortation centers” can also be explained in terms of their desire to gain better visibility and control of the “last mile” of package delivery (Wulfraat 2014; 2015).

What is interesting about the definitions of logistics included in this section is that they stress the temporality and timing of movement. I argue that the function of processing reveals that capital is as much what Wolfgang Ernst (2013) calls a time-critical process as it is a dromological phenomenon.²⁴⁴ Therefore, capital's processing media—the system that spans various docking infrastructures, barcodes and the UPC, POS-systems with scanners, POS-data, EDI, etc.—should be understood as a time-critical media system. What time-criticality reveals is that it is not the annihilation of space with time that is decisive; what is critical is that ships, trucks, and trains adhere to set schedules (Klose 2015:170).

6.2.4.2 Capital as a time-critical process

One of the general themes of new materialist media theory is that it tries to “understand the materiality of media through temporality” (Parikka 2012:75). Ernst's particular type of new materialism takes into account temporality that is radically non-human and is focused on the processes, flows, and signals that occur within digital media (Parikka 2011:55). In particular, he examines how cultural memory is recorded, preserved, and narrated after the archive becomes digital; archives are no longer silent, dusty places, but rumbling, electronic devices. Although the digital archive is as much a condition of statements and discourse as its analog counterpart, Ernst moves the archive away from spatiality being the central notion to that of time-criticality.

The temporalization of the archive is tied to the dissolution of the distinction between storage and transfer; the digital archive is no longer a stable storage place but is increasingly a function of “logistical interlinking” in time (Ernst in Parikka 2012:123). Because time-critical media have “minimal delay memories” that allow for “apparent live

²⁴⁴ Although Virilio does not operate with a notion of time-criticality, he does consider timetables and schedules to be a type of dromocratic governance. In *Negative Horizon*, he argues that “with the dromocratic revolution of transport, it is the administration of Time that starts to take shape. The interest in dominating time far more than territory already made its appearance in the cult of the train schedule” (Virilio 2005:57). In *Open Sky* he writes that “the organization of calendars and the measurement of time (clocks) have also presided over a vast chronopolitical regulation of human societies” (Virilio 1997:13).

transmission by calculation in real time,” there is no longer a choice between storage and transfer:

It turns out that storage is nothing but a limit value of transfer. Seen from a media-archeological perspective transfer and storage are two sides of one coin: storage is a transfer across a temporal distance. The traditional separation between transmission media and storage media becomes obsolete (Ernst 2013:100).

In digital media, archives are no longer spaces, but addresses: a “necessary precondition for any data retrieval is addressability, the necessity of being provided with an external—or even internal—address” (Ernst in Parikka 2011:58). Importantly, these addresses are more temporal than spatial in the sense that they refer to a schedule or sequence of events, such as “patterns of signals unfolding in time” (Parikka 2011:59). Time-criticality, therefore, refers to the “*decisiveness of the temporal event* that happens in the engineered channel” (Parikka 2011:59, emphasis added). In digital media, the exact timing is decisive for a process to take place, such as “the coming into being of an electronic image or real-time data processing in computers” (Ernst 2013:58).

Although Ernst developed the concept of time-criticality to explain digital media that reckon time in milliseconds or microseconds—what he refers to as micro-temporality—it can also be applied to analog media whose temporality follows the clock time of humans. While he has written little about economics, he considers time-criticality to apply to “post-modern just-in-time production in both industry and technologies, as well as in deadly situations like anti-aircraft prediction in Second World War” (Parikka and Ernst 2013:n.p.). Time-criticality as a concept can thus be used to understand the temporal basis or even rhythm of capital accumulation after the logistics revolution and the emergence of the stretched factory. More importantly, the concept of time-criticality can help to explain (1) how capital’s processing media function; (2) and therefore why such diverse technologies like distribution centers, ports and terminals, POS-systems, barcodes and the UPC, scanners and sensors, POS-data, EDI, and schedules function as a processing media system that; (3) makes the circulation of capital a time-critical process.

Ernst and Parker’s respective arguments that storage is a special case of transfer suggests that when it comes to material goods, storage was always already a limit value of transfer

if purely considered from the vantage point of circulation time. But this type of storage is nevertheless an interruption of transportation and not something that approaches transportation as a limit. But Ernst's argument applies to how the old warehouse was transformed into the distribution center, and in particular to the cross-docking facility, where commodities are in constant motion and merely pass through the facility as they are forwarded to their next location in the supply chain. Arguably, when the warehouse is no longer a place in which things are at rest but in constant motion, it appears as if storage is a limit value of transfer although what really occurs is a processing of movement.

Distribution centers and container terminals can, however, also be understood as being time-critical media. To function as time-critical processing media, however, they are dependent on real-time infrastructure of telecommunications and computers to coordinate the complex movements within the space of the distribution center or container terminal, and to map these movements onto the schedule of incoming and outgoing ships, trains or trucks. The stowage of containers on ships and trains is a case in point. To discharge a container from a vessel, an outgoing truck or an AGV to move it to the stack has to be summoned at the precise time for the entire loading and unloading process to go smoothly and allow to the cranes to operate as close to their technical capacity as possible. The choreography of containers, cranes, AGVs, and trucks at a maritime container terminal is an example of the larger just-in-time production and delivery system; the correct raw material, intermediate part, or for that matter container must be delivered within a narrow time window for immediate use.

It is precision scheduling—which really should be understood as a synonym for time-criticality—that allows for practices like cross-docking (Hoopes 2006:90). Walmart requires strict cooperation with its suppliers to deliver the right quantity of products at the right time—the window of delivery to a cross-docking distribution center is about fifteen minutes (Petrovich and Hamilton 2006:133). This precision scheduling is, however, dependent on the collection of information about where commodities are in the supply chain and on Walmart's communication system to transmit this information and schedules to their suppliers; indeed drawing up and keeping a schedule that manages the

movement of commodity capital is dependent on ICTs and sophisticated supply chain management software. While fifteen minutes is not an example of micro-temporality, it is nevertheless an example of time-criticality because this window of time is decisive for exchange to occur. If a truck misses the delivery window, it could lead to stock-outs in retail stores and thus potential loss of sales; but if on schedule, the commodities will be at the right retail store and at the right time for their conversion into money. Even in the case of a more classical storage facility, holding back inventory to wait for the right time to forward to the right place at the right time can also be understood as a type of processing of the formal movement of commodity capital.

Bernes argues that logistics “is the active power to coordinate and choreograph, the power to conjoin and split flows; to speed up and slow down; to change the type of commodity produced and its origin and destination point” (2013:n.p.). With distribution centers being the nexus between suppliers and retailers, they are therefore the sites where the circulation of commodity capital can be conjoined, split up, accelerated, and slowed down and so on. In other words, the distribution center is the primary medium with which to manipulate capital’s movement.

The schedule should itself be considered part of capital’s processing media system because it determines the critical moments in time that must be adhered to. Shippers, such as Walmart or any other capitalist enterprise that depends on container ships as media of transfer for their commodity capital, “are more sensitive to the frequency of departure than any other variable—including speed and cost” (Cudhay 2006:169-70). The more frequently a container ship line offers service on a particular string, the more likely shippers are to use the liner (Kendall and Buckley 2001:217).²⁴⁵ Lane Kendall and James Buckley explain that what underlines the “idea of liner service... is regularity—the dependable arrival and departure of ships at the ports listed in the itinerary and the

²⁴⁵ A string is a particular route that is serviced. For example, A.P. Møller – Maersk Group’s TP2 Westbound string links the US West Coast to China and South East Asia. Starting in the port of Long Beach, ships call at the port of Oakland before steaming across the Pacific to call at Busan in South Korea, then at the ports of Shanghai, Ningbo, and Chiwan in China, and finally Singapore for its final port of call (Maersk Line 2015).

timetables” (2001:224). Reliability is particularly important for just-in-time production and distribution (Bonacich and Wilson 2008:72-3). If the schedule has been dependable over an extended period of time, shippers come to rely on the established pattern and any disruption to this pattern will affect their business operations.²⁴⁶ The goal of drawing up a schedule is to meet the needs of shippers and ensure a profitable employment of the fleet of container ships.

When making a schedule, the following variables must be taken into account: the number of ports of call; the physical characteristics of these ports that may affect the movement of ships (harbor depth and tide); the hours (or schedule) when these ports operate; the prescribed steaming speed of the vessel; the turnaround time in ports (i.e. productivity); and if the cargo is intermodal, the schedule must be coordinated with the schedules of the railways and/or trucking companies (Kendall and Buckley 2001:219-22).²⁴⁷ Thus in a time-critical paradigm, various processes are mapped and made to function, if not as clockwork, then at least by the clock in tandem with the schedule.

Marx argued in the *Capital Vol. 2* that the frequency at which the means of communication operate leads to reduced circulation times even without acceleration (1978:327-8). The benefit of capital’s transfer media servicing a route between A and B more frequently is that

²⁴⁶ Shippers are particularly concerned that vessels depart on the scheduled day because “many international trade transactions are financed by letters of credit stipulating that goods be dispatched by a certain date. Failure to meet this requirement can interfere with the financing of the deal” (Kendall and Buckley 2001:217).

²⁴⁷ Interestingly, schedule makers do not allow for poor weather—a characteristic that makes (real) space a barrier— interfering with scheduled voyages unless reliable statistics can demonstrate that at certain times of the year it is impossible to maintain a given speed, which is the case with winter storms in the North Atlantic. Similarly, they assume that ports will not be disrupted by strikes, riots, or civil strife, that working conditions are stable, and that no major breakdown in equipment occurs. The only real space “barrier” that schedule makers take into account appears to be the geophysical phenomenon of the range of tides; if a port can only be navigated during high tides, the schedule must take the tides into account (Kendall and Buckley 2001:224). A dromological solution to this problem is to dredge the harbor so that ships can call even at low tides. Individual delays may not be serious and consume only a few hours, but cumulatively they can have dire effects on how a fleet of ships or a string operate and lead to overlapping of schedules (known as “bunching”) (Kendall and Buckley 2001:225-6).

successive quantities of goods can now start their journey at more closely spaced intervals, and thus arrive on the market one after the other... so that one part is steadily being transformed into money capital while another part circulates as commodity capital. *By this distribution of the reflux over several successive periods, the total circulation time is shortened...* (Marx 1978:328, emphasis added).²⁴⁸

A frequent and reliable schedule can consequently be understood, like increasing payload capacity of capital's transfer media, as being a type of acceleration of capital but without accelerating any motor vehicles.

Kendall and Buckley (2001:218) use the hypothetical example of a container ship line that owns some 20-knot ships and service a route between port A and B, which are separated by 4,800 miles of sea. This distance is covered in ten days; with four days for discharging and reloading vessels in each port, it would take a total of four weeks to steam between the two ports. A fortnightly service can, therefore, be maintained with two vessels. The frequency of schedule is important because it determines the minimum and maximum transit time for the sea and port legs of capital's circulation. If a shipper can deliver their cargo just a few hours before the vessel departs, the circulation time for their capital will be equal to the transit time. But if a shipper misses the scheduled time of departure, the cargo has to wait until the next ship departs, which in this example would be two weeks. The maximum transit time is twenty-six days, while the minimum is twelve.²⁴⁹ If two extra vessels are added to the string to make weekly departures possible, the maximum transit time would be reduced to nineteen days, while the minimum would remain at twelve days (Kendall and Buckley 2001:218).²⁵⁰ In other words, maximum transit time depends on the number of vessels servicing a particular string.

²⁴⁸ With reflux, Marx refers to the repatriation of money back to the capitalist or the company's headquarters.

²⁴⁹ Maximum transit time = fourteen days of waiting, ten days of steaming, and two days to discharge; minimum transit time = ten days of steaming and two days to discharge.

²⁵⁰ Maximum transit time = seven days of waiting, ten days of steaming, and two days to discharge.

6.2.4.3 The barrier of use-value (need)

I now turn to explain why capital's processing media overcomes the barrier of use-value (need). In *Grundrisse*, Marx writes that the commodity "contains a barrier—precisely the barrier consisting of the need for it—which... is measured not by the need of the producers but by the total need of all those engaged in exchange" (1973:405). As soon as demand for a particular use-value ceases in a geographical area, "it ceases to be a use-value... [and] an object of circulation" (Marx 1973:405). The barrier of use-value can be interpreted as a logistical problem of failing to match supply with demand or, based on my discussion of processing, a poor organization or positioning of commodity capital in space and time.

That the barrier of use-value refers to a logistical problem is evidenced by Marx's argument that this barrier is overcome by widening the sphere of circulation (1973:407).²⁵¹ Simply put, by sending the particular commodity to another location where there is demand for it, the barrier can be overcome. In other words, the barrier of use-value (need) is overcome by a more efficient organization or positioning of commodities in space. This efficiency is derived from tracking and recording both the movement and sale of commodities for knowing where and when the commodity should be forwarded. The purpose of logistics is to link supply with demand and to hold exactly the inventory needed in both quantity and mix in order to avoid the twin danger of overstocks and understocks. The existence of stocks of unsold commodities is clear evidence of the existence of the barrier of use-value (need) for those particular commodities.

²⁵¹ There are, of course, other ways in which capital can overcome the barrier of use-value, such as through advertising creating new needs or planned obsolescence whereby the use-value deliberately breaks or is programmed to stop working after a given lapse of time. On planned obsolescence, see Slade (2007). Harvey notes that the half-life of a "typical Fordist product" of five to seven years was, after the shift to flexible production, cut in half in some sectors (textile and clothing) and down to as little as eighteen months in parts of the culture industry (video games and software) (1990:157). The half-life of products has gone down even further, particularly in the textile and clothing sector where the late 1990s phenomenon of fast fashion became dominant. Even when it comes to material goods production, the half-life of electronics are particularly short. Americans, for example, replace their cell phones every fifteen to eighteen months.

Organizing commodities in time and space to overcome the barrier of use-value (need) is dependent on exploiting and mining the torrents of data collected at the point of sale. In chapter five, I briefly discussed the phenomenon of micro-merchandizing, which enables retailers to tailor specific inventories for regions or individual stores that reflect what customers in this region or store actually buy. POS-data can also be used to offer incentives like coupons, rebates, and two-for-one offers that may induce demand for a use-value that otherwise may already have been satisfied. More broadly, it is possible to understand how capital's processing media overcome the barrier of use-value if we consider them as a cybernetic system that relies on information collected at the point of sale and at various docks throughout the supply chain as corrective feedback to better match commodities with money at a particular point in time and space.

With reference to how apps installed on smartphones and tablets extract data about their users, Manzerolle and Kjøsén (2014) argue that capital has gained a real-time targeting system. By way of always-on devices, individuals become part of "a high-speed feedback loop fueled by a torrent of extracted, transmitted, stored and processed information about the... individual and its behaviour" (Manzerolle and Kjøsén 2014:152). They argue that it is through the closed loop of the app ecosystem (e.g. iOS and Android) that capital has "gained a targeting system" in which individuals and their devices are vectors that capital can access to launch "digitized commodities (such as apps and downloadable content) directly at the consumer, in a manner similar to how anti-aircraft batteries attempt to intercept planes or missiles by tracking them in real time" (Manzerolle and Kjøsén 2014:153). This targeting system calibrates its predictive targeting by aggregating and mining yet more extracted data from app and device usage.

Through collecting POS-data and tracking commodity capital's movement through the supply chain, capital also has a real-space targeting system. Commenting on the effects of electricity, McLuhan observed that there is "steady progression toward commercial exchange as the movement of information itself" (1994, 149). After the logistics revolution, this prophecy has arguably come true; the collection of data from the point of sale about the what, when, where, and who of selling is vital for the manipulation of capital's movement. When combined with loyalty cards, retailers can aggregate vast

amounts of data that will help them to track better their “constantly moving targets” by predicting—making assumptions about—when and where someone may want to purchase a commodity (Manzerolle and Kjøsén 2014). For example, by analyzing their POS-data, Target was able to predict who is pregnant, because pregnant women will buy particular commodities in a pattern following each trimester; the retailer could therefore send vouchers for commodities they know a customer will need as their pregnancy progresses (Manzerolle and Kjøsén 2014:154-5). The system aims to process for the consumer what needs they are looking to fulfill so that they arrive demanding what the retailer has ready to supply.

The examples of capital’s processing media that I discussed in part two and this chapter—including POS-systems, docks (distribution centers, ports, terminals), POS-data, barcode/UPC, sensor technology, and so on—can in the aggregate be considered capital’s targeting system. In this system, capital’s media function to overcome the barrier of use-value (need) through addressing and forwarding, effectively manipulating capital’s movement, speed, and direction so that commodities are at the right place, right time, and in the right quantity. This targeting system is time-critical and would not work if, for example, container ship lines did not operate on frequent and predictable schedules or if suppliers do not manage to arrive at a distribution center within the scheduled delivery window. This targeting system also allows for shipping commodities in a general direction with the final or next address provided during transit. Manzerolle and Kjøsén’s conceptualization of capital’s targeting system is remarkably close to what Amazon’s patent of anticipatory shipping, which I briefly described in chapter one.

The patent describes how packages may be shipped from a fulfillment center “in anticipation of a customer ordering items in that package, but before such an order has actually occurred” (Spiegel et. al. 2013:5). A “forecasting model” determines what items to ship by analyzing data collected about buying and browsing patterns; the “relatedness” of an item to this pattern; preferences explicitly expressed by the customer; demographic information; and “specific web pages viewed and duration of views, overall length of customer’s visit to [Amazon's web pages], links hovered over and duration of hovering, shopping cart or wish list activity” (Spiegel et. al. 2013:17). After commodities have been

determined and speculatively shipped to a general geographical area, orders placed for any of the commodities are used as corrective feedback to select the package in closest proximity to the final delivery location and to forward it to this location as soon as it passes a dock in the supply network (Spiegel et. al. 2013:8-9). If no order comes in, the package may be shipped to another geographical area where there may be a higher probability of orders coming in or convert “potential interest” into an order by offering it at a discount.

That this patent concerns the barrier of use-value is revealed in the problem that anticipatory shipping is supposed to solve. The patent notes that although there are many advantages of using a “virtual storefront” (i.e. real-time retailing), the “substantial disadvantage” of the model is that “customers cannot receive their merchandise immediately upon purchase, but must instead wait for the product to be shipped to them”, which may dissuade them from buying from Amazon, “*particularly if those items are more readily available locally*” (Spiegel et. al. 2013:1, emphasis added). By “positioning” their commodities closer to potential customers, Amazon hopes that they can lower the barrier of use-value to their commodities by appealing to customers who would otherwise demand the instant gratification of buying something in a brick and mortar store.

6.2.5 The barrier of equivalents

There is one barrier to capital identified by Marx that appears to defy categorization according to transfer, storage, and processing: the barrier of equivalents. This barrier refers to “the magnitude of *available equivalents*, primarily money” (Marx 1973:405). Simply put, for the commodity to complete its formal movement there must be money in sufficient quantity in a given location so that the commodity can be sold there. More precisely, there must also be enough money-owners because if a single individual owns all the equivalents in a particular local economy, only the commodities that this individual needs can be sold in that location. From this vantage point, the barrier of equivalents explains why, as I discussed in chapter one, food moves out of famine struck areas even though that is where food is desperately needed. In short, famines occur after

people have sold off what they own and food moves out of the famine-stricken area because a barrier of equivalents exists there.

Despite my difficulty in relating the barrier of equivalents to a particular media function, capital's media do function to overcome this particular barrier. In chapter five, I discussed payment systems and instruments, such as those of cash, checks, and credit. To understand why these media overcome the barrier of equivalents it is necessary to realise that this barrier can be interpreted as an issue of having access to either one's own money or credit. An individual may very well have enough money in her bank account to buy a particular commodity, but if this individual and others like her cannot access this money, the lack of access is in effect a barrier of equivalents. For example, without checks, ATMs, and credit card, the only way to access money was to go to a bank and withdraw it as cash. If the banks were closed there would be no way to access this money. ATMs solve the problem of banks' opening times by providing access round the clock, although only in particular locations. Checks and payment cards (debit and credit) in combination with the payment system they are part of, provide access to money as long as the merchant you buy from accepts the particular payment method.

Credit is the best example of how capital can overcome the barrier of equivalents because it provides individuals lacking equivalent with money that they normally would not have available, and thus with the ability to buy. In addition, people tend to spend more when buying things on credit thus leading to higher sales volume; in addition to providing access to money, credit cards thus lower the barrier of equivalents because people are more likely to buy something when payment can be deferred (Rambure and Nacamuli 2008:37). The combination of electronic payment and virtual storefronts also means people can buy any time of night or day.

6.2.6 General functions

The general functions of capital's media are an effect or aggregate of the particular functions of transfer, storage, and processing. In the conclusion to chapter one, I referred to these particular functions as collectively "preparing commodities for the market so that they can perform exchanges." Thus, in general, capital's media prepare the commodity

for circulation, but this preparation is specifically for the transfer, storage, and processing of the commodity's formal movement (C—M) as a material process in space and time. In other words, capital's media generally function to materially mediate the formal movement of capital (C—M—C), but this material mediation is a sequence whereby capital in commodity or money form is transferred, stored, and processed.

In the same manner that the commodity's guardian provides value with logistical support so that it can appear in the form of value (i.e. exchange-value/money), the general function of capital's media can also be understood as providing capital with logistical support in the sphere of circulation. This support includes organizing capital in commodity and money form in time and space, transporting or transmitting capital in these forms, preserving and protecting them, and importantly by overcoming the barriers in circulation. I connected the concept of barrier to Marx's argument that although capital must maintain its "inner unity" by assuming and discarding all of its particular forms and pass through its stages in succession, because these stages are external and separate in space and time, it is never a guarantee that a given capital value will maintain its inner unity. Part of the difficulty of maintaining capital's unity in circulation is because of the barriers of space, time, use-value (perishability), use-value (need), and equivalents. But because capital's media in the aggregate overcome or at least lower these barriers, they generally function to maintain capital's unity in the sphere of circulation and as such provide capital with logistical support in circulation.

In the discussion of the different functions of capital's media, there is one particular category that deserved particular attention in addition to "barrier," namely circulation time. Although it is itself a barrier, circulation time can also be understood as the category in which the efficiency of capital's media is expressed. Even though it is the function of accelerated transfer that directly overcomes circulation time, improved processing media also reduce circulation time. The massive reductions in maritime circulation afforded by increased productivity in ports is a case in point. Even capital's storage media act on circulation time by either extending it in the case of preservation or protecting the existing circulation lifetime of the commodity.

In chapter two, I discussed how the commodity in various “steps towards its final form” is what links, aligns, or integrates different circuits of capital into a supply chain. That is, circuits of capital are linked by the circulation of commodities. But because commodities cannot circulate by their own volition, they rely on capital’s media to materially mediate this formal movement and move from one step of production to the next in the stretched factory. Thus another general function of capital’s media is to contribute to the supply chain’s function of integrating and expelling matter because it occurs in and through the circulation process. In turn, this matter in the economic guise of commodity capital must be transported, stored, and given a direction and a schedule. At the same time, this particular movement requires the opposite movement of money because the commodity can only complete its movement by assuming money form.

The primary function of capital’s media is, however, to contribute to the general conditions of production in providing the mode of production with elasticity to expand production by leaps and bounds. As production develops and changes in terms of the volume and speed of output, it requires dependable, regular, and fast systems for both supply and distribution. If commodity capital cannot be circulated according to the speed and volume at which they are produced, the mode of production has no elasticity because it cannot efficiently convert these commodities into money which means that circulation is a bottleneck that slows down capital accumulation. And if capital is not accumulated, the production process cannot be reproduced on an expanded scale. Similarly, if production cannot be supplied with the correct quantity of means of production (including raw material and machinery) at the right time and place, it is impossible for production to expand elastically. As part of the general conditions of production, capital’s media’s general function of materially mediating the circulation process of capital is revealed to be a fettering or elastic function that depends on whether capital’s media are inadequate or adequate to a particular period of the mode of production.

6.3 Conclusion: the media category

A thing is a medium for capital if it functions within and for the circulation process. That is, being a medium is not something things inherently are, but is rather a form or category in which they appear. Although it is only now that I make this formal argument, it is only

a more general version of the argument I made in chapter one about the commodity's guardian being logically the first example of capital's media we encounter in *Capital*. The commodity's guardian makes his entrance in the second chapter of *Capital Vol. 1*, which concerns the process of exchange and is therefore narratively set within the sphere and process of circulation. The guardian thus appears *within the circulation process* and by transferring the commodity to the market and exchanging it the guardian functions *for the circulation process*. Specifically, by carrying out this function, the guardian materially mediates the commodity's formal movement $C—M$. But because functioning within the circulation process should be understood in terms of the particular functions of transfer, storage, and processing, the guardian more accurately appears in the category of capital's transfer media.

By qualifying transportation as something that appears within and for the circulation process, Marx argues that although transportation is in essence production, from the vantage point of circulation it appears as a circulation process. As Richard Gunn (1987:58-9) argues, in Marx's system the expressions "appearance" and "form" are the mode of existence of something. As he notes appearance is not, however, dualistically opposed to essence, but rather that "it is in and through appearance that the essence is" (Gunn 1987:59). Applying this argument to a means of transportation like a container ship, which would appear as a machine within and for the production process, means that it is in the mode of existence as capital's media from the vantage point of circulation. While a container ship would typically be viewed as fixed capital (machinery) and analyzed in terms of how it produces relative surplus-value, when it is viewed as functioning within and for the circulation process, the speed and capacity of the ship is analyzed in terms of how it reduces circulation time by overcoming the barriers of space and time.

To clarify my argument that media is a category of form, it is helpful to understand that Marx argued that things may assume different social forms depending on how they function in the process of social production, i.e. where this thing is positioned in the circuit of capital. For example, a house "when it functions as a place of work, is a fixed component of productive capital; when it functions as a dwelling, it is in no way a form

of capital in this capacity” (Marx 1978:282). Moreover, as a product of a capitalist production process, the house would appear in the economic form of the commodity that is ready to perform exchanges, albeit without physically moving. Speaking of a machine, Marx makes the same argument:

It is only the function of a product as means of labour in the production process that makes it fixed capital. It is in no way fixed capital itself, just as it emerges from the process. A machine that is the product and thus the commodity of a machine-builder is part of his commodity capital. It only becomes fixed capital in the hands of its buyer, the capitalist who employs it productively (1978:240).²⁵²

What Marx argues here is that when the machine emerges from the production process, it is positioned within the sphere of circulation and therefore cannot be a machine (fixed capital); things are machinery only if they are located in the sphere of production and function for the process of production.

Taking this argument further, Marx argues that things may even appear within two different categories or forms simultaneously. To explain this dual functional existence, I draw on an argument from Marx that I already used to explain why capital’s media can be considered McLuhanite extensions of the forms of capital in circulation. Marx argues that when cotton or coal is in transit, they “form the object of labour for the transport industry... and commodity capital in circulation for the coal producer of the cotton broker” (1978:366). In other words, the cotton and the coal are at one and the same time productive capital and commodity capital, albeit from the different points of view of the transporter or the coal producer and cotton broker.

That things can have a dual functional existence (that is, appear in different economic forms) is, next to the circulationist point of view, the most important puzzle piece for understanding what capital’s media are. To build on Marx’s example, because they move the commodity capital of the coal producer and the cotton broker, the ship, train, or beasts

²⁵² Throughout *Capital Vol. 2*, Marx makes many similar arguments to stress how things have a functional existence in the social process of production (see Marx 1978:241, 282, 456-7, 516).

of burden of the transporter function and therefore appear as media within and for the respective circulation processes of the coal producer and cotton broker. A container ship becomes a medium only for the capitalist whose commodity capital it is materially circulating in space, even though in the hands of the shipper, the container ship is a machine, i.e. a fixed component of his productive capital.

This argument can be taken even further and applied to the particular categories of capital's media that correspond to the functions of transfer, storage, and processing. While anything that either transfers, stores, or processes commodity or money capital appears in the general category of capital's media, any individual medium appears in one or more of the particular categories. For example, the standard container functions as both a medium of transfer and storage. As the core component of the intermodal transportation system, the standard container is a medium of transfer, but in its capacity to protect or preserve its commodity contents, it is a medium of storage. Similarly, the container ship is a transfer medium, but because a key component is the cell guides that allows for the secure stacking of containers that in turn reduces the likelihood of losing the cargo, it is a medium of storage or a classical container technology as Lebel (2015) argues. A facility like a food/perishables distribution center functions as a storage medium because it maintains a temperature controlled environment to slow down the entropy of the commodities that pass through it, but because the facility also forwards or routes these commodities on to their next position in the supply chain, it is also a processing medium.

In the introduction to this chapter, I reiterated a methodological argument Marx makes about his critique of political economy. Accusing bourgeois economists of turning social characteristics into the natural characteristics of things, such as the fetishistic belief that the individual commodity has value, Marx argues that the economist confuses the form of appearance or mode of existence for the thing that appears in that form (1976:714). Hence the reason why Marx develops categories based on specific social functions rather than coming up with definitions under which things are subsumed (Marx 1978:303). As I wrote in the introduction, to argue that something is inherently a medium is tantamount to expressing a fetishism of media. Thus if a thing or a system of things functions to

overcome the barriers of space and time, it appears in the category of capital's transfer media; if it overcomes the barrier of use-value (preservation), it appears in the category of capital's storage media; if it overcomes the barrier of use-value (need), it appears in the category of capital's processing media. Whether a thing is a medium of commodity capital or money capital depends on whether it is transferring, storing, or processing either commodities or money.

Table 1 depicts capital's media ontology in terms of particular functions and economic forms. Accordingly, the table shows six particular media categories and one general category. The left side is divided according to media theory's function of transfer, storage, and processing; shows the barrier that this function overcomes; and by what particular material mediation it is overcome. The right side of the table depicts the economic form that is mediated and what things appear in the particular categories of commodity capital and money capital's transfer, storage, and processing media. Because the general functions of capital's media are an aggregate of the particular functions, I have listed them below the particular functions. As the table shows, the things that appear in the general category are all the things that function within and for the circulation process. Within the confines of this dissertation, it refers to all examples discussed in chapters three through six as a totality. There are, however, many other examples of things that function as capital's media, some of the more important ones being: energy infrastructure like pipelines, electrical masts, bulk vessels, oil drums and tanks; air freight, including airplanes, airports, and air freight containers; the retail environment; advertising; and the real-time financial infrastructure of, for example, high-frequency trading.

Table 1: Capital's media ontology

Function			Commodity	Money
<i>Particular</i>	<i>Barrier(s)</i>	<i>Material mediation</i>	$C'—M'$	$M—C$
Transfer	Space and circulation time	Acceleration, capacity, changing land use, transportation, transmission, broadcasting	Vehicles (trains, trucks, ships, guardian, beasts of burden), infrastructure (railways, highways, fiber optic cables), consumer packaging, the internet, intermodal transportation, standard container, postal systems, couriers (UPS, DHL)	Payment systems (VISA), armoured vans, postal systems, couriers (UPS, DHL)
Storage	Use-value (perishability)	Preservation, protection from elements and theft, measures of precaution	Standard container, reefers, secondary packaging, perishables distribution centers, corner fittings, twist locks, cell guides, digital rights management/trusted systems, anti-theft systems	Safes, vaults, armoured vans, encryption
Processing	Use-value (need)	Organizing things in space and time, forwarding, addressing, positioning, routing, manipulation of movement	Distribution centers, ports, terminals, POS-systems, barcode/UPC, ICTs, labels, POS-data, addresses	Payment systems (VISA), automated clearing and settling houses (ACSH)
	Equivalents	N/A	N/A	Payment cards (debit/credit), credit, ATMs,
General			Circulating capital (C—M—C)	
	All	Logistical support, integrating circuits, moving matter, elasticity	Capital's total media system (the physical conditions of circulation)	

As I argued in the introduction to the dissertation, the concept of media in Marxism was an empty category that had to be filled with content and become a rich totality of many determinations and relations. Although it is the functions listed in Table 1 that are specifically expressed in the various categories of capital's media, these functions imply additional content. Following my analysis from chapter one and onwards, what is included in the concept of capital's media are: value, the value form, commodity, money,

circulation (the metamorphosis/formal movement of value), exchange (buying/selling), the guardian, the market, and the commodity's immanent contradiction as an engine for movement. In chapter two: the general conditions of production, the circuit of capital, the supply chain as the spatial grid for movement, and adequate and inadequate media. In chapters three through six, I included what Garnham refers to as the physical, spatial, and temporal moments of capital; what de la Haye refers to as the vast ensemble of infrastructure and vehicles or what Parker refers to as the communication networks of the sphere of circulation.

6.4 Afterword

I now comment on the position of the preceding theory of capital's media in media studies as a discipline. In concentrating on the logistical aspect of capital's media, my circulationist approach *could* apply to what is more conventionally thought of as media and some of the concerns of cultural studies and political economy. To illustrate how such an application can be made I use the example of smartphone apps (and social media use), which I already discussed briefly in terms of how capital's processing media can be understood as a targeting system. Apps, in other words, lie at the triangulated intersection of capital's media, cultural studies, and political economy.

6.4.1 Cultural studies

While cultural studies certainly cannot be reduced to being focused only on issues of subjectivity, identity, and representation, they collectively represent one of the core concerns of the field of study (Grossberg 1996). As the Birmingham school of cultural studies and in particular Stuart Hall has argued persuasively, identity and its representation are sites of struggle that often occur on the terrain of the mass media. It is, for example, through the mass media that black bodies are inscribed with additional meaning (e.g. criminal, dangerous, and thug), which is a surplus of connotation that white bodies never have to carry as an oppressive burden. It is in and through mass media, including apps and social media, that these meanings are contested, resisted, and reconfigured. Before I continue with this line of analysis, I first comment on the relative position of capital's media vis-à-vis the mass media in the capitalist mode of production.

For this positioning, I take a cue from Louis Althusser's (2001) essay on "Ideology and Ideological State Apparatuses", which I find to not only be persuasive but also to be particularly compatible with my approach. This compatibility has its basis in Althusser's argument that the function of ideology concerns the reproduction of the conditions of production and his reliance on *Capital Vol. 2* for making this argument. Althusser argues that every social formation (feudalism, capitalism) must be reproduced, which occurs specifically through the reproduction of the existing productive forces and the social relations of production. Importantly, he notes that "the reproduction of the material conditions of production cannot be thought at the level of the firm" (Althusser 2001:86). In other words, Althusser argues, albeit without using the term, that reproduction must be thought of at the level of the general conditions of production.

Althusser is, however, more interested in how labour-power is reproduced. Noting how the wage tells only a part of the story about how labour-power is reproduced, he argues that, for example, skills, knowledge, and "'rules' of good behaviour" are learned and reproduced through ideological state apparatuses (ISAs), which refers to institutions like education, the trade unions, and importantly the mass media (Althusser 2001:88-9). Specifically, these ISAs contribute to the reproduction of capital through its ideological function of interpellating individuals as subjects who, in turn, behave in a manner that aids in the reproduction of capital, such as being obedient, turning up for work every day, and cause no problem while working (Althusser 2001:96). These ISAs, including the mass media, are positioned side-by-side with capital's media in the general conditions of production. Hence, the function of the ISAs is as necessary for the reproduction of capital as is the buying and selling of commodities and the material mediation of circulation by capital's media.

On the basis of this positioning of the mass media, it is possible to link subject or identity formation as not only a moment of the overall reproduction process of capital but also as specific moments in the circulation process of the circuit of capital. With his argument that individuals are the personification of economic categories, Marx had already made this argument: subject positions become nodes for carrying out social functions, such as buying, selling, and valorizing (Kjøsen 2013). But in addition to carrying out the

structural necessities of capital, subject positions can also become nodes from which capital can extract information that is used to enhance the vector of capital's circulation (Manzerolle and Kjösen 2012; 2014). This is precisely what occurs at the point of sale: data about the buying subject is collected through scanning barcodes, loyalty cards, and payment cards, but through the apps ecosystem the amount of data possible to extract increases by orders of magnitude.

Manzerolle and Kjösen argue that digital devices (smartphones and tablets) and social media that interpellate individuals as communicative subjects also translate and absorb individual and social behaviour, such as making social connections and communicating on Facebook, into usable flows of data (2012; 2014). When apps creators and social media companies offer users the possibility of “personalizing” your profile or account by selecting gender, race, occupation, interests, and so on, they are effectively interpellating individuals as granular subjects. This interpellation, however, is part and parcel of the tendency of digital media to incorporate the identity and relationships of a user into the apps ecosystem itself in order to piggyback “the circulatory requirements of capital onto the social relationships (...) of communicating subjects” with the result that “our social being is [transformed] into multiplying nodes in the process and vectorization of circulation” (Manzerolle and Kjösen 2012:224, 225). What Manzerolle and Kjösen argue with regards to apps is that when apps users—whether enthusiastically, begrudgingly, or through willful ignorance—take time to carefully present their “self” they are calibrating capital's targeting system, making it easier for capital to match a commodity with a potential buyer.

6.4.2 Political economy

In Marxist political economy approaches to the mass media there is a tendency to focus on the issues of profitability and the conditions of labour within particular media corporations and sectors. By challenging what constitutes media-based labour, this dissertation argues that such analyses could be extended to include the broad sector of logistics. But more importantly, it argues that labour can also be analyzed from the vantage point of circulation if this labour is employed in an industry that has a liminal

status as functioning within and for both the production and circulation processes of capital.

This theory can be seen as being part of a continuum that includes Smythe's analysis of the role of mass media. While I disagree with some of the specifics of his argument—whatever the audience does, it is not work—I nevertheless agree that the function of the mass media concerns demand management and that the general function of media is to sell commodities. In this dissertation, I have argued that capital's media also concern selling in its function of mediating the commodity's material and formal movement by, among other things, transporting it to the market. Smythe's theory is complementary with that of capital's media; the mass media and capital's media, such as railways and ships, are but two different components of a larger media system for converting commodities into money. The commodities that are advertised in the mass media must find their way to the right market, at the right time, and in the right quantity so that the ad pays off for the advertiser when the former audience members buy the marketed commodities.

This argument can be extended to the digital labour or political economy of social media debate, which broadly centers on questions of whether social media use is a type of labour and whether this labour is productive of surplus-value (see e.g. Terranova 2004; Caraway 2011; 2015; Fuchs 2010; 2012; 2014; Arvidsson and Colleoni 2012; McGuigan and Manzerolle 2014; Rigi and Pray 2015). Building on the autonomist Marxists concept of immaterial labour, Tiziana Terranova was the first to propose that online activities or behaviour constitutes “free labour,” which she conceptualizes as “the moment where knowledgeable consumption of culture is translated into excess productive activities that are pleurably embraced and at the same time often shamelessly exploited” (2004:78).

Although building on the work of Smythe rather than the autonomists, Fuchs (2010; 2012; 2014) has been the most vocal proponent for the thesis that digital prosumers or free labourers create surplus-value, arguing that the “production of surplus value and hence exploitation is not limited to wage-labor but reaches society as a whole” (2010:188). According to Fuchs, any and all participation on platforms like Facebook and YouTube is labour that is extremely exploited because people posting, liking, and

commenting work completely for free; because no wage is paid, it is an infinite exploitation (2012:714).²⁵³ The commodity that this type of labour produces is “informational content” (such as status updates, likes, personal profiles, comments) that are sold as commodities by social media companies; the “infinite” surplus-value produced by digital prosumers is objectified in this commodity (Fuchs 2010; 2012).

A number of critiques have been levelled particularly at the argument that participation on social media platforms can create surplus-value (e.g. Caraway 2011; 2016; Arvidsson and Colleoni 2012; Rigi and Pray 2015). Brett Caraway, for example, argues that because no wage is paid, so-called free labour must per definition be unproductive of surplus-value. Comparing digital prosumption to domestic work as being necessary, albeit unproductive, Caraway argues instead that such free labour “contributes to value only by reducing the cost of labor power and the means of production to capital” (2015:64). For example, by creating and updating open source software that can be installed and used gratis, businesses do not need to invest in buying proprietary software thus lowering the overall costs of the means of production for said company. Jakob Rigi and Robert Prey (2015) make a similar critique to that of Caraway, but argue that free labour makes websites, apps, or social media sites more attractive to advertisers as a marketing platform. They therefore argue that “the price of an ad is a rent paid for advertising space” (2015:392). In other words, companies like Facebook and Google do not make any profits based on exploiting the labour of their users, but from charging rent from their “ad-tenants.”

Whether surplus-value or a type of rent can be extracted from digital labour is of less interest from a circulation point of view. A circulationist approach to social media and apps examines how so-called digital labour functions within and for the circulationist process. Manzerolle and Kjøsén argue that in a similar manner to how industrial

²⁵³ Fuchs argument that exploitation is infinite is based on a serious misunderstanding of Marx’s algebra. Marx argues that the rate of exploitation and surplus-value is given by the formula “s/v” where s refers to surplus-value and v to variable capital, which is represented in the wage of the worker. Because no wage is paid to social media participants, v = 0. Dividing a number by zero, however, does not equal infinity; any number divided by zero is rather undefined (Caraway 2016:70).

machinery absorbed the “physical and intellectual capacities of the worker in the sphere of production, our networked environment and digital devices absorb our sociality and movement through space and time as streams of [data]” (2014:155). They do not, however, argue that this sociality and movement are labour nor that it is productive of value: “In the sphere of circulation, it is not surplus-value that can be extracted from communicative and intellectual activities; it is [data], via the apps running on smartphones and tablets” (Manzerolle and Kjösen 2014:156). These data are in turn processed into abstractions which are conceptually used to understand a mass of consumers that in turn can be used to persuade individuals to buy particular commodities or offer specific commodities to specific individuals.

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