

## **Neither Modularity Nor Relational Contracting:**

### **Inter-Firm Collaboration in the New Economy.**

#### **A Critique of Langlois and Lamoreaux, Raff, and Temin**

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**Forthcoming in *Enterprise and Society* 5, 3 (September 2004)**

In a series of recent essays, including their contributions to this symposium, Richard Langlois and Naomi Lamoreaux, Daniel Raff, and Peter Temin [hereafter LRT] present interesting but contradictory views of the decentralized or vertically disintegrated post-Chandlerian economy, from whose vantage point they seek to found a reconceptualization of business history.<sup>1</sup> Starting from an orientation that uneasily combines Adam Smith's ideas about the division of labor and organizational learning, Langlois sees the current situation as dominated by the modularization of production. This modularization and the arm's-length transactions it facilitates creates a world reminiscent of the antebellum US, but different from the latter in that today's high-throughput, differentiated exchanges are underpinned by a set of market-supporting institutions, notably standard interfaces or design rules. Starting from an orientation towards Oliver Williamson and the minimization of coordination costs, LRT in contrast see a world of collaborators joined by long-term relations of a distinct type not reducible to either markets nor hierarchies.

In this comment, we will argue that these views are both off the mark. LRT are right to argue that the post-Chandlerian new economy, far from being limited to market exchanges among black box makers, is deeply collaborative. But we will see that this

collaboration is directed at innovative learning in a way consistent with Langlois's general orientation (though not his particular arguments about modularization or his specific interpretation of Adam Smith). It is also more formalized, and formalized in a different way, than the repeated-game reputational transacting framework adopted by LRT allows.

Our argument proceeds in three steps. In part I, we briefly characterize the contrasting views of Langlois and LRT with an eye to the internal tensions and gaps in their positions. In part II, we focus on two salient, complementary features of the post-Chandlerian new economy that figure prominently in contemporary managerial discussions but are at odds with both accounts on offer. The first, which counts against the Langlois view, are the limits to modularization: the impossibility of establishing standard design interfaces so comprehensive and stable that customers and suppliers can in effect interact as if operating in spot markets for complex components or subassemblies without jeopardizing their long-term survival. The second, which counts against the LRT view, are the profusion of innovative disciplines and practices of co-design such as simultaneous engineering, benchmarking, co-location of personnel, problem-solving teams, processual quality standards, and the like. By routinely obligating collaborators to question and clarify their assumptions about their joint project, these disciplines allow for a corrigible partitioning of tasks within and across firm boundaries in ways that fixed modular interfaces do not. But they also formalize cooperation in ways that are inconsistent with the informal, "relational ties" at the heart of the LRT view.

In part III we set these controversies about the post-Chandlerian new economy in

the context of broader debates about the interpretation and direction of business history. We underscore those common features in the views of Langlois and LRT that give rise to their symmetrical (over- and under-formalized) misinterpretations of contemporary developments. Both sets of authors explicitly disavow historicism, understood as the thesis that history is determined by the unfolding of an immanent tendency or deep logic. In that sense, they purport to break with Chandler, who saw the rise of the modern corporation as a functional response to the imperatives of markets and technology. But disclaimers aside, Langlois is openly committed to what might be called multi-dimensional historicism: the view that historical development is determined by the interaction of two or more independent but simultaneously operative logics or tendencies. And he is arguably correct in presenting his view as an explication and clarification of the related view of LRT – though given the ambiguity of their position, the latter can undoubtedly find grounds to reject this claim. Looking beyond these intramural disputes, we will argue that this post-Chandlerian historicism adds little to our understanding of business history, while potentially subtracting a great deal by short-circuiting analysis of the actual detailed operations of the economy that allow us to identify truly novel developments and their antecedents. By way of conclusion, we draw out two lessons for contemporary business historians who truly want to move beyond historicism, and show how their application directs attention to just those aspects of the current situation that confound these all-too-Chandlerian views of the post-Chandlerian economy.

### **I. Two Views of the Post-Chandlerian New Economy**

Langlois and LRT are appealingly eclectic and sometimes speculative in their theoretical approaches. To make the most of what they say, and to focus debate on

essentials, we present here only what we take to be their respective core commitments, leaving aside discussion of the ambiguities and lacunae that necessarily accompany efforts at broad historical synthesis.

Langlois's view of the post-Chandlerian new economy recalls the pre-Chandlerian antebellum US economy in that it marks a return to vertical specialization, general-purpose technologies, and the coordination of decentralized production through market exchange. But where the antebellum world was semi-autarkic, Langlois's new economy is "a high-throughput system, with flows of work even more closely coordinated than in a classic Chandlerian hierarchy".<sup>2</sup> This novel combination of features depends crucially on the development of market-supporting institutions, particularly technical standards or design rules which standardize the interfaces between organizationally separate stages of production. Because this standardization of interfaces drastically reduces the volume of information required for inter-firm coordination, the tendency of the new economy is to transform products into fully modular or decomposable systems.<sup>3</sup> Since the modules themselves can serve many purposes, they can be produced in high volume and combined to yield a variety of customized goods matched to differentiated consumer demand. Whereas advances in the division of labor for Adam Smith led to increasing specialization of tools, tasks, and skills, in Langlois's elaboration of Smith's views, they lead to a profusion of modules produced using general-purpose tools by specialized firms along with periodic refinement of the interfaces that allow for recombination of modules across firms. Whereas the central task of the Chandlerian firm was to buffer uncertainty and coordinate interdependent phases of production and distribution so as to ensure the utilization of high fixed-cost specialized

assets, standards and modules now allow firms to achieve economies of scale and scope through the market.<sup>4</sup> The key task of the post-Chandlerian firm becomes correspondingly innovative, largely tacit learning within the framework established by modular standards. As Langlois puts it in an earlier article, “Firms arise as islands of non-modularity in a sea of modularity”.<sup>5</sup>

But Langlois’s view of the post-Chandlerian economy depends on a suspiciously delicate balance between tacit learning within firms on the one hand and a generalizing formalization of this learning in standard interfaces on the other. In the article just referred to, Langlois himself clearly identifies one of the principal obstacles to this division of roles between firms and market. “Unpredictable novelty” and dynamic learning, he writes, could make the “hard encapsulation” of boundaries between units within modular systems undesirable:

“[T]he tasks in an innovative development project cannot be partitioned in advance, since knowledge is continually changing. In such a case, the modularization of the system...has to change continually; moreover, the modularization at any point has to take into account the inevitability of remodularization as learning takes place”.<sup>6</sup>

Since innovative development projects are surely characteristic of the new economy, this is tantamount to saying that modularization, at least in the form of entrenched standards, cannot be.

To square this circle, Langlois refers to Garud and Jain’s proposal of “the ideal of a *just-embedded* system, that is a system in which the visible design rules are *enabling* –

firm enough to encourage modular innovation and recombination – but loose enough not to be constraining to the evolution of the system.”<sup>7</sup> But whether and to what extent the real currently approaches such an ideal is not least an empirical question. Langlois himself acknowledges that establishing such systems “may be easier said than done”;<sup>8</sup> and after reviewing LRT’s view of the post-Chandlerian economy, we will present evidence in the next section that his doubts are very much warranted.

LRT present the post-Chandlerian new economy as a shift away from coordination through managerial hierarchies within vertically integrated firms towards coordination through long-term relationships between (networks) of formally separate firms, based on “informal restraints on self-interested behavior” among the transacting parties.<sup>9</sup> Like Langlois, they see a return to something like the antebellum economy. But where Langlois emphasizes the dominance of the market over the firm in the earlier period, LRT highlight the social bonds that underpinned economic relations then and now. In the pre-Chandlerian era, they write, “businesspeople in...industrial communities interacted socially as well as economically, and the resulting multidimensional relationships facilitated cooperation for purposes besides production”.<sup>10</sup> The contemporary resurgence of relational coordination in their view is underpinned by cost-reducing advances in transportation and communication technology which enable decentralized networks of firms to respond more flexibly to the increasingly differentiated demands of consumers with rising per capita incomes.

More specifically, LRT identify long-term relationships as a third major type of economic coordination mechanism beyond market exchange and hierarchy, of particular value “where there is a great deal of uncertainty about the direction of technological

change and both parties can benefit from the pooling of information and resources that trust makes possible”.<sup>11</sup> To provide some theoretical underpinning for this view, LRT refer to the recent game-theoretic analysis of relational or informal contracting developed by Baker, Gibbons, and Murphy.<sup>12</sup> That model is an elegant and ingenious attempt to integrate the contractualist and property-based approaches to the structure of the firm. The part of the model relevant here formally demonstrates the possibility that under some conditions it will be easier to sustain relational contracts between upstream suppliers and downstream customers when the suppliers are independent firms and therefore have the ability to hedge against defection by threatening to sell their products to alternative customers in spot markets. Put another way, the chief advantage of formal deverticalization of the firm is to create the possibility for sustained informal cooperation between independent producers, exactly the opposite of the highly formalized exchanges at the center of Langlois’s analysis.

This analysis of deverticalization might seem nearly vacuous for present purposes, in that it severely limits the possibilities for further analysis of the structure of the new economy, as the key inter-firm relations are informal, largely unobservable, and susceptible only to ad hoc managerial intervention in designing, communicating, implementing, monitoring, and changing relational contracts. But as we will see next, the one strong empirical claim that the model does make – regarding informality – turns out to be no more credible than Langlois’s contrary claim regarding modularity.

## **II. Two Symmetrical Misinterpretations of the Post-Chandlerian New Economy: Over- and Under-Formalization**

Two central themes of current discussion of the new post-Chandlerian economy

are surprisingly peripheral to the analyses of both Langlois and LRT. The first is the relentlessly innovative character of the new economy and along with it the vulnerability of all currently successful product designs to challenge from alternatives. A subtheme of this discussion is that modularization, by entrenching deep assumptions about the design of products or product classes, is a self-limiting strategy. The second theme is the need, given this innovative churning, for firms to develop reliable disciplines for identifying new possibilities and learning rapidly how to incorporate novel approaches into their product designs and production techniques. Taken together, the vast literature on these themes portrays the new economy as much more concerned with elaborating techniques for co-design and co-development within and among firms than with either informal relations between collaborators or market exchanges between module makers and their customers.

Take first the theme of a relentlessly churning economic world and the associated claims about the riskiness of modularization. This is the world of “disruptive” technologies described by Christensen and colleagues at the Harvard Business School. A disruptive technology is a superior alternative to the currently dominant know how, whose potential escapes the most masterful producers and users of the dominant method precisely because their experience teaches how to improve on what they already know and how to find flaws in upstart challengers. Disruptive technologies therefore begin to realize their potential in secondary or peripheral markets of no interest to the dominant players. Proven there by “outsider” firms, they are generalized to core domains of application, dislodging the incumbent producers. (Famous examples include electric-arc or mini-mill steel producers, hydraulically activated earth-moving equipment, and, of



course, in the realm of general production technologies—lean production.) All established technologies are in principle disruptable in this way. The result is an economy in which winners take all for a short time, and their victories are short because of a self-limiting cognitive property of success itself.<sup>13</sup>

Under these conditions, the stabilization of technical interface standards is a two-edged sword. Some standardization is obviously necessary to allow specialists to focus on the complex subsystems in which they have distinctive capabilities. But too much standardization can just as obviously become a barrier to systematic innovation and lock component manufacturers into a potentially obsolete product architecture.

Excessive commitment to a particular product architecture and accompanying interface standards can thus lead to what Chesborough calls a “modularity trap”.

Within the firm, the focus on developing products to compete within the standard eventually erodes the amount of system-level knowledge....While focused firms are effective in linking to the established architecture, they lack the knowledge to envision how to connect to a new architecture. Within the industry, the collection of focused competitors that modularity enthusiasts celebrate...now lack the collective knowledge of how to evolve the system. They may also lack the ability to take collective action, necessary to coordinate a shift from one system of highly interconnected parts to a new system of connections.<sup>14</sup>

For just these reasons, firms in most industries seek to avoid risky, irreversible

commitments to a single product architecture and technical interface standards.<sup>15</sup>

Typically, too, lead firms do not break products down into fixed modules defined by a one-to-one mapping between a function and the physical devices that embody it, but instead engage in a process of iterated co-design with component suppliers, in which complex wholes are provisionally parsed into parts whose subsequent development then suggests modifications of the initial overall design, which are then provisionally parsed again, and so on. At any given moment, suppliers may be engaged in manufacturing “black box” parts defined by the interfaces of a particular product architecture, but the most capable (and best remunerated) are also expected to assist their customers in redefining those interfaces for cost reduction and performance improvement in the next design iteration.

Detailed studies from particular industrial sectors reinforce these general conclusions. Thus in the electronics sector, often taken as the pre-eminent example of pure modularity, arm’s-length coordination among specialists based on standard technical interfaces is less common than is often claimed. Timothy Sturgeon, who presents such “modular production networks” as a new and potentially dominant form of industrial organization based on the transfer of highly codified product specifications between vertically specialized firms, concedes that such contract manufacturing accounted in 2000 for just 13% of the market for circuit-board and product-level electronics.<sup>16</sup> And Sturgeon himself has gone on to acknowledge that “as contractors seek new sources of revenue by providing additional inputs to lead firm design and business processes, and new circuit-board assembly technologies appear on the scene, such as those for boards with optical components, the hand-off of design specifications is becoming more

complex and less standardized, making it harder for lead firms to switch and share suppliers”, while requiring “closer collaboration in the realm of product design”.<sup>17</sup>

Similarly, much recent writing on complex mechanical assembly industries such as motor vehicles, aerospace, construction machinery, and agricultural equipment, insists that integrality in product architecture and associated systems integration capabilities remain crucial to ensure the smooth and safe interaction among numerous subsystems and components on the one hand, and to develop distinctive and attractive new models under intense time pressures on the other. “Mega-suppliers” in the automobile and other industries that bet heavily on the possibility of thoroughgoing and robust modularization have regularly failed to win a sufficient share of business from final assemblers to cover their overheads.<sup>18</sup>

Langlois is aware of these limits to modularization, but he seeks to immunize his argument against them in two ways. The first is simply to minimize their empirical significance.

Although modularity in a deep sense lies behind all decentralization...I do not want to be understood as saying that the Chandlerian corporation is giving way to pure modular systems and anonymous arm's-length markets. In many cases, the visible hand has indeed been socialized into technical standards that permit external mechanisms of coordination and reduce the need for rich information transfer. In other cases, however, products will continue to maintain significant 'integrality', and relationships between stages will often be collaborative ones involving trust, permanence, and the transfer of rich information....As a central

tendency, however, the buffering functions of management are devolving to the mechanisms of modularity and the market – informational decomposition, flexibility, and risk spreading.<sup>19</sup>

But this seems more like an obiter dictum than a considered weighing of the evidence.

His second response is simply to assert that modularity traps and related dilemmas are more apparent than real. Thus, implicitly relying on the assumption that the ideal of a just-embedded modular system is not only practical but already common practice, he insists that new forms of inter-firm collaboration in industries like automobile manufacturing should not be understood “as arising out of a demodularization in which encapsulation has been eliminated in favor of intense communication”, because “rather than handing suppliers detailed instructions, manufacturers now give suppliers interface specifications and the encouraging them to design the parts as they see fit.”<sup>20</sup> But this claim simply ignores a second central theme in current discussions of the new economy: the iterative process of co-design whereby suppliers contribute to the redefinition of interface specifications for new products based on their experience in manufacturing existing models.

The new collaborative disciplines of iterated co-design have become an utterly familiar part of the new economy under the name of Japanese production methods, although they are no longer limited to Japanese firms or those in close association with them. Indeed it is almost impossible to survey recent writings about the new economy without stumbling across extended reference to them.<sup>21</sup>

These methods establish a first idea of what to produce (and how) through

benchmarking: an exacting survey of current products and processes, supplemented by assessments of what new and unproved techniques that might become available for use. Once benchmarking provides a provisional starting point, design follows a disciplined, decentralized process known as simultaneous engineering. Each subunit responsible for a constituent component proposes modifications of the initial plan, while also considering the implication of like proposals from the other subunits for its own activities. Provisional designs are thus evaluated and refined, and the cost of each attribute is compared to its contribution to functionality using the techniques of value analysis/value engineering. Once production begins, systems of error detection and correction use breakdowns in the new routines to trigger searches for weaknesses of the design or production process that escaped earlier examination.<sup>22</sup> The goal of such root cause analysis is to trace disruption back to its original source, which may not be palpably linked to the proximate cause of the breakdown. Moreover, the exchanges of information required to engage in benchmarking, simultaneous engineering, and error detection and correction also allow the collaborators to monitor one another's activities, closely enough to detect performance failures and deception before they lead to disastrous consequences. Ultimately, these information exchanges lead the actors to convergent understandings of the world they are exploring. We can think of these disciplines as pragmatist, in the sense that they oblige firms routinely to question the suitability of their current routines and continuously to readjust their ends and means to one another in light of the results of such questioning.<sup>23</sup>

Taken together, these new pragmatist disciplines play an important part both in mitigating the cognitive self-limitation at the heart of the innovator's dilemma and in

shaping the links that connect firms in the new economy to each other. They increase the mutual transparency of the actors to each other essentially by revealing to each how widely and rigorously the others scan for solutions in addressing joint problems of design or quality. In the form of benchmarking or root-cause analysis, for example, they require the actors to undertake searches that are unbounded *ex ante* (consider all the products “like” the one you want to build; assume that the root cause of a problem will have no direct connection to the proximate cause), yet sufficiently informative to produce a serviceable map of the available solution space. As each party monitors the others’ search process, tacit knowledge is rendered at least partly explicit, easing long-range collaboration (by reducing the chances that the parties take incompatible things for granted) and reducing the chance that all the parties cling to the same dangerously limited assumption (by routinely disrupting the disposition to take the same things for granted). These disciplines thus mitigate the risks of modularity by decomposing complex systems into recombining chunks while providing elements of a form of governance of inter-firm relations that goes beyond informal relational contracting. Put another way, these disciplines point towards a form of flexible or continuously corrigible formalization that blurs the distinction between tacit and fully explicit knowledge at the heart of Langlois’s analysis, and that between informal and rigidly specified governance at the heart of the LRT story.

### **III. Meta Lessons for Business History**

Although Langlois and LRT spend a good deal of time trying to establish a theoretical framework for explaining the relationship between the pre- and post-Chandlerian decentralization of production, we find this speculation premature. Given

the sharp contrast in their views, and what we take to be the disconnect between both of their positions and key features of the new economy, it would be mere happenstance if either hit on an overarching explanation which connects the earlier period to a trenchant analysis of the current one (and we will return to this disjuncture below). Instead of commenting on their broad explanations, we limit ourselves by way of conclusion to noting how Langlois and LRT infringe two principles that we think should guide investigation in history generally and business history in particular.

The first principle is no historicism. By historicism, we simply mean a commitment to any variant of the view that historical developments are determined by the unfolding of some deep logic of functional necessity. Nowadays, of course, almost no one admits to being a historicist in this sense; and Langlois and LRT are as one in distancing themselves from Chandler's historicist insistence that the visible hand of the vertically integrated firm was the inevitable terminus of increases in the division of labor (linked of course to increases in the size of the market, in part through technological development). But what Langlois dismisses through the front door, he readmits through the back. He sees the organization of economic activity as determined by the interaction of not one but two developmental tendencies. The first is the thickening or extension of markets. On historical timescales, markets thicken monotonically. The second is the urgency of (organizational) buffering, determined by the degree to which the technology of production is complex, sequential, and high-throughput. In Langlois's neo-Smithian picture, the urgency of buffering the advancing division of labor was low in the semi-autarkic low-throughput antebellum economy. Buffering becomes important in the age of Chandlerian mass production with its tightly coupled, vertically interdependent task

structure. (This could be called the Smithian moment of his interpretation.) Finally, the need for buffering is now declining despite continuing increases in the division of labor because of technologically driven decreases in the efficient size of plants and the diffusion of market-supporting institutions such as standard interfaces. It is true that in Langlois's version, the path of historical progress in some sense curves back on itself. But adding this curve to the story remains faithful to the fundamental historicist assumption that history always has some inevitable outcome.<sup>24</sup>

Langlois is at some pains to show that the overarching interpretation developed by LRT can be assimilated to his own schema. It is not for us to adjudicate his claim. Given the radical differences between his account of collaboration in the new economy and that presented by LRT, it is worth noting that any affinity between his metahistorical scheme and theirs is not a sign of a deep and mutually confirmatory convergence of views, but rather a hint that both constructions are freestanding rationalizations of the coarse facts of business development over the past two hundred years, disconnected from any in-depth analysis of the current situation.

But even if LRT do not prove to be historicist, we think that it is not unfair to find them in violation of our second metahistorical principle: no deterministic contextualism. By this infelicitous phrase we just mean that business historians and historians more generally should never assume that actors' decisions are never fully determined by the contexts in they find themselves. Or put the point in a slightly different way, actors are never just reading the script for their actions from the circumstances they confront. Their own reflections and interpretations, including especially reflections on possible changes in what seem like fixed constraints and political alliances, are crucial ingredients in their



strategic choices. And the interplay of these reflexively contingent choices, of course, creates the context in which they and other actors make subsequent decisions. In this way, actor and environment co-evolve, and it is always possible to find a good fit between choices and choice-shaping circumstances, but is a mistake to see the circumstances as simply determining the choices.<sup>25</sup>

LRT claim that they found a way of respecting this principle, while preserving the possibility of rigorous economic explanation of businesspeople's choices among alternative coordination mechanisms and their adaptation to changing circumstances. In their words:

Although in hindsight there appears to have been a clear economic logic to the pattern of successful and unsuccessful adaptations, we argue that there was nothing predetermined about these outcomes. The advantage of our focus on heterogeneity – on the multiplicity of ways in which businesses have responded to change – is that it enables us to maintain a dual perspective through which we can both elucidate the economic logic of the choices that were made and, at the same time, retain a sense of their contingency.<sup>26</sup>

Maybe. There are practical interpretations of this statement of principle which might respect the no deterministic contextualism rule. An indispensable characteristic of this class of practical applications is the exploration of the actual heterogeneity of choice and the way it reshapes the contextual constraints on further decision making. We have looked in vain in their proposal, as in Langlois's, for such a treatment (or indeed any in-

depth historical analysis) of the passage from the Chandlerian to the post-Chandlerian firm. Rather, as Langlois observes, a variant of the conventional transaction-cost economics of organization seems to be doing the explanatory work in their account.

We always thought that Chandler's story was not the whole tale. There were historical alternatives to mass production that he ignored, and potential successors to it that he first overlooked, and then sought to explain away even as they came to dominate events.<sup>27</sup> Now that we are all post-Chandlerians, it is high time to think about ways to build together a history of the possible and the real in business development that – neither historicist nor contextualist – sharpens our eyes for the continuing surprises of the present and their still more surprising connection to the past.<sup>28</sup>

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<sup>1</sup> In addition to their articles in this issue, see especially Richard N. Langlois, “The Vanishing Hand: The Changing Dynamics of Industrial Capitalism”, *Industrial and Corporate Change* 12: 351-85; Naomi R. Lamoreaux, Daniel M.G. Raff, and Peter Temin, “Beyond Markets and Hierarchies: Towards a New Synthesis of American Business History”, *American Historical Review* 108 (2003), 404-33.

<sup>2</sup> Langlois, “Vanishing Hand”, 373.

<sup>3</sup> *Ibid.*, 374.

<sup>4</sup> See also Richard N. Langlois, “Chandler in a Larger Frame: Markets, Transaction Costs, and Organizational Form in History”, *Enterprise and Society*, this issue, 20 [ref. to MS. Version].

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- <sup>5</sup> Richard N. Langlois, “Modularity in Technology and Organization”, *Journal of Economic Behavior & Organization* 49 (2002), 34.
- <sup>6</sup> *Ibid.*, 25.
- <sup>7</sup> *Ibid.*, 26, citing R. Garud and S. Jain, “The Embeddedness of Technological Systems”, *Advances in Strategic Management* 13, 389-408.
- <sup>8</sup> Langlois, “Modularity”, 26.
- <sup>9</sup> Lamoreaux et al., “Beyond Markets and Hierarchies”, 62. [Note to editors: we used the online version of this article posted by the History Cooperative, and hope that you will be able to convert the page references to the version published in *AHR*.]
- <sup>10</sup> *Ibid.*, 34.
- <sup>11</sup> *Ibid.*, 11.
- <sup>12</sup> George Baker, Robert Gibbons, and Kevin J. Murphy, “Relational Contracts and the Theory of the Firm”, *Quarterly Journal of Economics* 116 (2002), 39-84.
- <sup>13</sup> See especially Clayton M. Christensen, *The Innovator’s Dilemma* (Boston, MA, 1997).
- <sup>14</sup> Henry Chesbrough, “Towards a Dynamics of Modularity: A Cyclical Model of Technical Advance”, in Andrea Prencipe, Andrew Davies, and Michael Hobday (eds.), *The Business of Systems Integration* (Oxford, 2004), 181.
- <sup>15</sup> Cf. for example the emergence of a family of distinct but compatible standards as a result of inter-firm and international competition in third generation mobile telecommunications, as described by Henrik Glimstedt, “Competitive Dynamics of Technological Standardization: The Case of Third Generation Cellular

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Communications”, *Industry and Innovation* 8 (2001), 49-78.

- <sup>16</sup> Timothy J. Sturgeon, “Modular Production Networks: A New American Model of Industrial Organization”, *Industrial and Corporate Change* 11 (2002), 460. Langlois repeatedly cites Sturgeon’s article as an authoritative source for his claims about modularization as the key feature of the new post-Chandlerian economy: see “Vanishing Hand”, 372-3; “Chandler in a Larger Frame”, n. 1.
- <sup>17</sup> Gary Gereffi, John Humphrey, and Timothy Sturgeon, “The Governance of Global Value Chains”, forthcoming in *Review of International Political Economy*, typescript version, November 4, 2003, p. 14.
- <sup>18</sup> Gary Herrigel, “Emerging Strategies and Forms of Governance in High-Wage Component Manufacturing Regions”, forthcoming in *Industry and Innovation* 11 (2004); Mari Sako, “Modularity and Outsourcing: The Nature of Co-evolution of Product Architecture and Organizational Architecture in the Global Automotive Industry”, in Prencipe et al., *Business of Systems Integration*, 229-53.
- <sup>19</sup> Langlois, “Vanishing Hand”, 376.
- <sup>20</sup> Langlois, “Modularity”, 34.
- <sup>21</sup> Thus, for example, in discussing the value of long-term collaborative relationships based on voice rather than exit, LRT (“Beyond Markets and Hierarchies”, 51), refer to Steven Spear and H. Kent Bowen, “Decoding the DNA of the Toyota Production System”, *Harvard Business Review* (Sept.-Oct. 1999), 97-106. This article provides a useful discussion of the disciplines by which Toyota tests and revises the assumptions underpinning its production rules, but says nothing about the informal relations which

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they seem to suppose lie at the heart of “Japanese” production networks.

<sup>22</sup> Langlois notes the possibility of using disruption as a cue for problem solving and continuous improvement, but confuses the form of tight coupling by just-in-time inventory systems with the non-decomposability of production and erroneously concludes that it would be beneficial “only for some kinds of relatively stable systems where frequent change is not important” (Langlois, “Modularity”, 24). Any textbook on Japanese production methods will demonstrate that root-cause analysis and related problem-solving techniques are especially useful to reduce set-up times and otherwise facilitate small-batch production in volatile environments.

<sup>23</sup> For a fuller discussion, on which this presentation draws, see Susan Helper, John Paul MacDuffie, and Charles F. Sabel, “Pragmatic Collaborations: Advancing Knowledge While Controlling Opportunism”, *Industrial and Corporate Change* 9, 443-83.

<sup>24</sup> Langlois (“Vanishing Hand”, 377, n. 39; cf. also “Chandler in a Larger Frame”, 22) spends a few words on a disclaimer regarding the possibility that markets can thin as well as thicken, but leaving aside the fact that historicists as different as Adam Smith and Karl Marx both anticipated the possibility of retrocession within frameworks establishing the necessity of progress, his picture shows only forward movement.

<sup>25</sup> For our own efforts to elaborate an approach to business history respective of these two principles, see Charles F. Sabel and Jonathan Zeitlin, “Historical Alternatives to Mass Production: Politics, Markets and Technology in Nineteenth-Century Industrialization”, *Past and Present* 108 (1985), 133-76; idem, “Stories, Strategies, Structures: Rethinking Historical Alternatives to Mass Production”, in Charles F. Sabel and Jonathan Zeitlin



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(eds.), *World of Possibilities: Flexibility and Mass Production in Western Industrialization* (Cambridge, UK, 1997), 1-33; Jonathan Zeitlin, “Productive Alternatives: Flexibility, Governance, and Strategic Choice in Industrial History”, in Franco Amatori and Geoffrey Jones (eds.), *Business History Around the World* (Cambridge, UK, 2003), 62-80.

<sup>26</sup> Lamoreaux et al., “Beyond Markets and Hierarchies”, 3.

<sup>27</sup> For the latter moves, see Alfred D. Chandler, Jr., “The Competitive Performance of US Industrial Enterprises since the Second World War”, *Business History Review* 68 (1994), 1-72; idem, *Inventing the Electronic Century: The Epic Story of the Consumer Electronics and Computer Industries* (New York, 2001).

<sup>28</sup> For the distinctive insight such a perspective can yield in reinterpreting US business history during the Chandlerian era, see Gerald Berk, *Alternative Tracks: The Constitution of American Industrial Order, 1865-1917* (Baltimore, MD, 1994); idem, “Neither Markets Nor Administration: Brandeis and the Antitrust Reforms of 1914”, *Studies in American Political Development* 8 (1994), 24-59; idem, “Whose Hubris? Brandeis, Scientific Management and the Railroads”, in Kenneth Lipartito and David Sicilia (eds.), *Constructing Corporate America: History, Politics, Culture* (Oxford, UK, forthcoming 2004); idem, “Organizing Economic Diversity: Antitrust, Associations and Accounting in the United States, 1906-1929”, unpublished paper presented to the conference on “Constructing Markets, Shaping Production”, Idöborg, Sweden, July 5-6, 2002; Gerald Berk and Marc Schneiberg, “Varieties in Capitalism, Varieties of Association: Collaborative Learning in American Industries, 1900 to 1925”,

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unpublished paper, University of Oregon/Reed College, October 2003. The key finding of Berk's recent work is that, contrary to the claims of both Chandler and transaction-costs economics, cost structures in American industry from the railroads to commercial printing were not exogenous constraints determined by underlying market and technological conditions. They were instead contingent constructs which could be transformed through deliberate experimentation and collective learning, by methods such as uniform cost accounting and benchmarking that prefigure the pragmatic forms of inter-firm collaboration in the post-Chandlerian new economy.