Ford Automates: Technology and Organization in Theory and Practice

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Manufacturing is the heart of a manufacturing company. A troubled manufacturing company invariably requires significant improvements in the management of this activity.

Most of the key aspects of manufacturing are of a professional nature. The manufacturing organization's key executives must be well educated and have broad experience. A manufacturing organization led and primarily staffed by men who worked their way up from the shop floor is inappropriate today. If this is the case, it may be one of the company's problems.

Eugene F. Finkin, *Successful Corporate Turnarounds* (1987), p. 91

The Rouge in 1945 was very confused. The deterioration since he had left was shocking. "Ford was a gone goose." The Bennett-Rausch group had just about wrecked the place. Few wanted to have anything to do with the situation in the Rouge. No one knew who reported to whom; the lines of authority were indistinct. If Willow Run had been badly administered, the Rouge was in far worse shape.

Notes on Interview with Charles Patterson, Vice President, Ford Motor Company, November 13, 1959, as recorded by F.E. Hill and M. Wilkins, Ford Archives

By the late 1940s, the U.S. auto industry had adopted the structure and strategy it would pursue for nearly 40 years. Well-defined tasks eased the burden of automating, since a dedicated machine could be assigned to each special task. This policy led to inflexible automation, so that by the 1960s, even a small change in the dimensions of an engine would require millions of dollars for new tooling.

Michael L. Dertouzos et al., eds., *Made in America: Regaining the Productive Edge* (1989), pp. 176-177

The central problem I wish to address in this paper is the reorganization of the Ford Motor Company after 1945 and the development of Ford's automation program. By all accounts, Ford Motor Company hovered near organizational and

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[1]This paper draws heavily on my extensive article on the Ford Motor Company's Cleveland Engine Plant, which is cited in the bibliography. My focus here is on organizational issues, a subject I barely touched in my article.

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technological collapse in 1945. Yet when production began six years later at its new Cleveland Engine Plant, the company was hailed as the pioneer of automation, the leader of the new wave of production technology that swept through American manufacturing in the 1950s [2; 13]. For a brief period, Ford's top executives and its public relations department touted automation as a revolutionary development in American manufacturing that would soon give rise to the workerless factory [16]. Fear of automation spread quickly throughout the ranks of Ford's production workers and, more generally, the American workforce. Perceived as a major threat to the livelihoods of American workers, the development of automation led to two congressional inquiries, the first in 1955 [26] and the second in 1960 [27], and to intense discussion at all levels of American society. By the time of the first series of hearings, the Ford Motor Company had abandoned its revolutionary rhetoric about automation, but it embraced the new technology even more firmly in spite of already-apparent problems of inflexibility. Since 1948, owing in part to its substantial investment in automation, the company had reversed its downward course, had recovered a significant share of the U.S. automobile market, and had returned handsome profits to its owners. (See Figure 1.)

How did Ford move from being perceived as a company in which *rigor mortis* had already set in to one perceived as the leader of a revolutionary, productive new technology in such a short span of time? Given that Ford Motor Company was consciously reorganized after 1945 by applying the management principles of General Motors--especially those involving decentralization--how did Ford wind up with a production system that was in many ways more Fordist than in the glory days of Henry Ford?

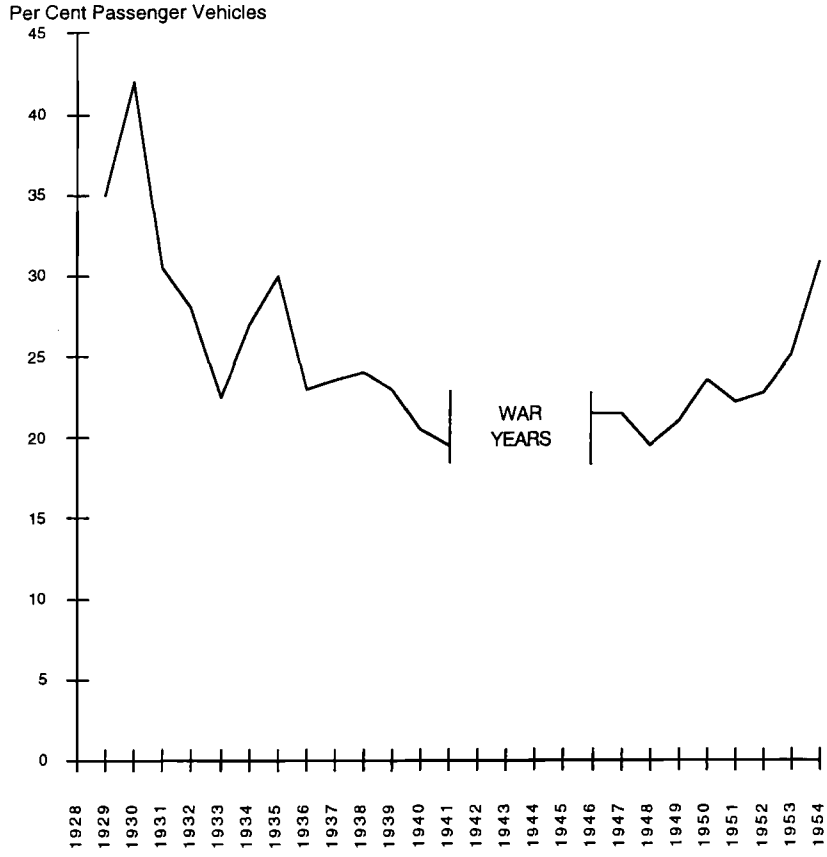
The story of the long, steady decline of the Ford Motor Company from the peak of the 1920s to the dramatic succession of Henry Ford II, grandson of the elder Ford, has been masterfully told by the team of historians assembled under Allan Nevins. The third volume of this monumental history of Ford Motor Company, which appeared in 1962, chronicles the "rebirth" of the firm under the leadership of Henry Ford II and the mentor he recruited from General Motors, Ernest Breech [21]. As this study makes clear, the reorganization of Ford Motor Company was carried out using blueprints from General Motors, at that time, the largest and most success corporation in the world. The architects of this reorganization were by no means novices at reading and understanding these blueprints. A large number of them were seasoned executives from General Motors, and the remainder of the reorganization team were taught about General Motors through Peter Drucker's now-classic 1946 book, *The Concept of the Corporation*, which reified General Motors, its organizational structure, and its managerial principles [7].

Ford: Decline and Rebirth articulates clearly how the General Motors model was brought to Ford and how it was promoted within the company. Yet it is less direct in stating how difficult applying the General Motors model to Ford proved to be. In fact, the authors provide little or no indication of the struggle waged within Ford over how far the company would go in recreating itself in the image of General Motors. Perhaps they were unaware of the struggle, or perhaps they saw it as being peripheral to their interpretation. But my research suggests that the struggle was more than academic. The debate went well beyond the theory of the modern corporation. It moved very quickly to the very heart of the Ford Motor Company--to Ford's system of production, its in-place assets, its ingrained patterns of thought, and its organizational routines. Even before what became the Cleveland

Engine Plant was authorized, how Ford would produce engines became a central focus for debate over the degree to which Ford would emulate General Motors. The company's decision to build the Cleveland Engine Plant constituted the end of the debate. The old order--the Fordist ideal, not old Ford managers--triumphed. The company committed itself more deeply to the principles of mass production and centralized control of production than ever before.

FIGURE 1

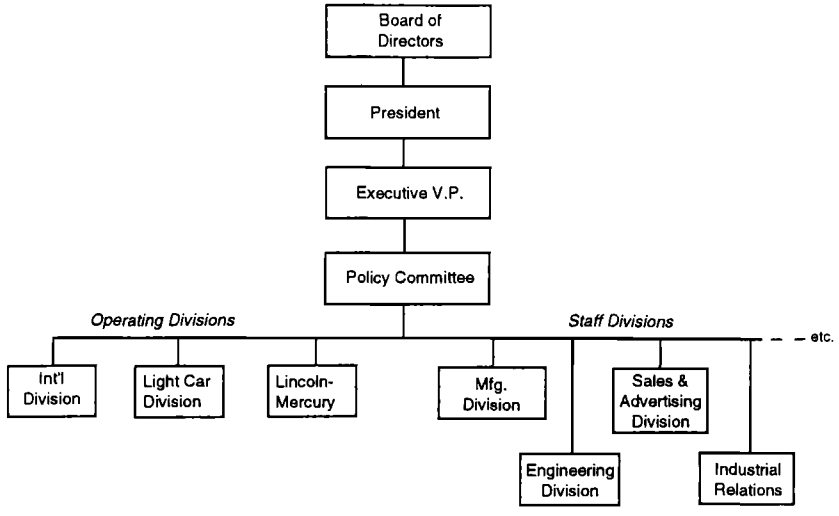
FORD'S SHARE OF THE U.S. AUTOMOBILE MARKET



SOURCE: Ford Motor Company Annual Reports, 1947, 1954.

The dominant theory of decentralized management to which many of the top managers recruited from General Motors clung centered on the existence of divisions and the principle of divisional autonomy [7; 4]. When they looked at Ford Motor Company, they saw only a tiny hint of divisionalization. Even before Ernest Breech arrived at Ford Motor Company, Henry Ford II had taken a step toward decentralization by creating a distinct Lincoln-Mercury Division nominally in charge of its own development, manufacturing, and marketing. (See Figure 2.) Here emphasis must be placed on the word "nominally" because such conditions existed mainly in theory and not in practice.

FIGURE 2
FORD MOTOR COMPANY ORGANIZATION, AUGUST 1946

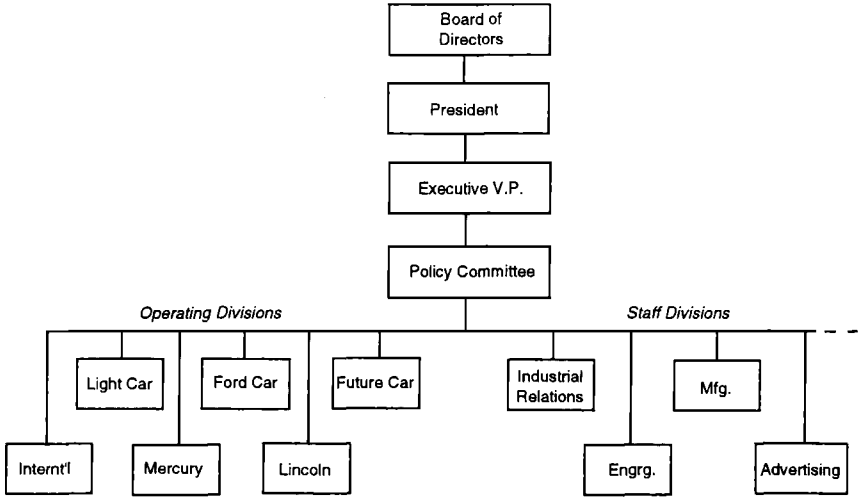


SOURCE: Adapted from *Report of Management Meeting*, May 1947.

When they considered the future of the Ford Motor Company, the GM men envisaged a multi-divisional firm that might look like the following. It would consist of at least four automobile divisions: a new one that would manufacture and sell a light, fuel-efficient vehicle comparable to European automobiles; a Ford Division that would manufacture and market a car called a Ford that corresponded to the type of car already made by the company; a Mercury Division that would manufacture and market a hotter, perhaps larger, and certainly more expensive car than the Ford Division; and a Lincoln Division that would make and market a

luxury car that could compete head-to-head with GM's Cadillac. In the future, Ford Motor Company might add another division such that the company could have complete coverage of the market--a "car for every purse and purpose" in the immortal words of GM's Alfred Sloan. (See Figure 3.) This was the theory held by the GM guys and toward which they fervently worked.

FIGURE 3
THE "GM PLAN" FOR FORD MOTOR COMPANY, C.1946-1948



SOURCE: Author's Interpretation of Ford Executives' Discussions on Organization, 1946-1948.

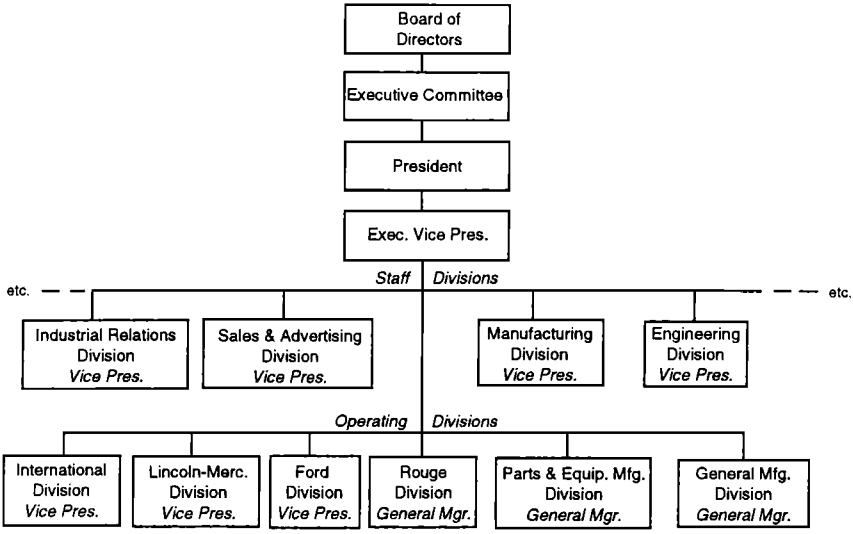
Reality soon got in the way of theory, however. First, unlike General Motors, Ford Motor Company was not a organization that had been built out of a loose assemblage of acquisitions. Ford was the manifestation of a dominant idea of producing a solid, low-cost automobile [15]. Nowhere was this ideal better exemplified than in the company's River Rouge plant. With the exceptions of regional assembly plants and some Lincoln operations, virtually everything that the Ford Motor Company made was produced at the Rouge. The scale of and investment in the Rouge proved to be too big to ignore; the Rouge loomed so large

in the company's operations as to make alternatives to it difficult, if not impossible, to conceive.

Second, although some executives were attracted to the idea of the company's manufacturing a light vehicle and establishing an autonomous light vehicle division, as time passed, the forces against the light car gained ground. By 1949, the idea was dead. With one division down, the plan for multiple divisions, each possessing its own manufacturing facilities, began to give way.

The creation of a separate Ford Division within the Ford Motor Company in 1949 made clear the conflict between theory and practice in decentralization. (See Figure 4.) Headed by Lewis Crusoe, an executive with years of experience at General Motors who held tightly to the ideal of divisional autonomy, the new Ford Division moved very quickly to garner control over its own manufacturing operations. This ploy failed almost as quickly, because the company's manufacturing operations had been so thoroughly centralized at the Rouge that ceding control over manufacture to the Ford Division meant ceding control over the Rouge. It also effectively meant demoting the corporate vice president for manufacturing to a position down in the hierarchy of the division. Given the dominance of production in the company's history, that simply was not going to happen.

FIGURE 4
FORD MOTOR COMPANY ORGANIZATION, FEBRUARY 1949



SOURCE: Adapted from 1949 Ford Motor Company Organization Chart, Ford Industrial Archives.

Fourth, beginning in mid-1949, Ford executives made a series of decisions they associated with decentralization of the company, but in fact these decisions initially obscured what decentralization meant. Here I allude to decisions they made to locate parts production facilities outside the Rouge (and indeed outside Detroit). The goal was to lessen the company's dependence on the Rouge for parts production; the goal was to make the company less vulnerable to labor action. General Motors clearly provided the inspiration for this series of decisions [24; 25; 28]. After GM lost the sitdown strike at Flint and was forced to recognize the UAW, the company made a conscious decision to weaken the effects of labor's new power through distributing parts manufacturing plants geographically.

Following a crippling, twenty-four day strike at the Rouge in the spring of 1949 that cost the company millions of lost labor-hours at a time when demand for its 1949 automobile was unprecedented, Ford executives decided to build parts production capacity outside Detroit [12, 1949]. The first of these plants was authorized immediately after the strike ended through arbitration and before a new agreement was reached with the UAW. Executives chose to build a sheet steel stamping plant in Buffalo, New York, that would take jobs away from the Rouge's body stamping operations even though the economics of alternative locations showed that the lowest unit costs, transportation costs, and other costs would be realized through simply expanding the Rouge's operations. This decision, the new Ford Division head Lewis Crusoe believed, opened a window of opportunity for his new division to claim organizational control over the new plant and to begin creating an autonomous manufacturing department, thereby liberating the Ford Division from the Rouge. This question was left up in the air for a brief period while executives studied the questions of what kind of engines the company would have in its new model automobiles and where and how it would produce those engines.

The settlement of what Ford executives called "the forward engine program" determined in very large measure the organization of the entire company. The vice president for manufacturing, a former GM production expert named Delmar Harder, had in 1947 reorganized engine manufacture at the Rouge plant, but even then he continued to argue that the company needed a new engine plant. The existing engine plant could not handle the capacity increases being contemplated. Overcrowding hampered production efficiencies, and smooth changeovers to new engine types would be impossible. By early 1949, before the establishment of the Ford Division, members of the company's Forward Product Planning Committee had determined that the company needed to build a new engine plant to make a new six-cylinder overhead valve engine.

By November 1949, however, following the creation of the Ford Division and the major strike at the Rouge, the company's new Facilities Committee concluded that more radical steps should be taken. First, the company should demolish its existing engine plant at the Rouge (the so-called Motor Building) and relocate and upgrade machinery from the Motor Building to the Rouge's Parts and Accessories Building. This plant would make 4,135 of the classic Ford V-8 engines per day. In addition, the company should build two completely new engine plants, one to make the new overhead valve six-cylinder engine for the Ford automobile (2,205 per day), and the other to produce a new--and larger--overhead valve V-8

engine of the Mercury (1,973 per day) and a still-larger-bore engine of the same Mercury block for the Lincoln (376 per day) [10].

The Facilities Committee had arrived at this recommendation to the company's new Executive Committee based not only on the projected production requirements for the new model Ford, Mercury, and Lincoln automobiles, but in accordance with two fundamental principles. The first was that the company should reduce its dependence on the Rouge for parts manufacture to fifty percent of the company's needs. The second principle was that the company's divisions should have their own production capacities. The committee's plan would essentially give the new Ford Division organizational control over the relocated engine plant at the Rouge and one of the new plants. The Lincoln-Mercury Division would have control over its own engine plant as well. As executives deliberated, Lewis Crusoe made clear that he was eyeing the Buffalo stamping plant, then under construction, for control by his Ford Division. (At the same time, executives were also contemplating how to meet the production needs for newly projected transmissions for the new models, so here too was yet another opportunity for the Ford Division to gain additional manufacturing assets.) The Executive Committee approved the recommendation of the Facilities Committee on November 4, 1949.

The ink had barely dried on the Executive Committee's approval, however, when Robert S. McNamara, one of the Whiz Kids [3] who was now Ford Motor Company's Controller and who had been a member of the Facilities Committee, put forth an alternative idea--"Plan A" [19]. It essentially questioned the assumptions under which the Facilities Committee had formulated its report. McNamara's plan preserved the principle of organizational separation (i.e., "Engine machining and assembly must be segregated by end product division without regard to engine interchangeability or relative operating costs of different plant sizes") but shifted the production of the new Ford 6 back to the Rouge. It thus violated one of the committee's explicit criteria, which was to lower the Rouge's production to 50% of the company's total engine needs. McNamara suggested that the company simply purchase castings for the new Ford 6 as well as those for the new Lincoln V-8. With some minor rearranging, he argued, the Rouge's foundry could produce the castings for the new Mercury V-8. He also suggested other alternatives to the approved plan, including using the company's Detroit-Lincoln plant for engine manufacture. Plan A, McNamara maintained, would save the company some $46 million in investment and manufacturing costs. McNamara's proposal threw Ford's top executives into a spin and put Harder very much on the defensive.

The Executive Committee met in early December 1949 to reconsider its earlier decision in light of McNamara's Plan A [8]. It summoned a large number of interested parties and the members of the Facilities Committee, including McNamara, to attend the meeting. Harder first presented his department's assessment of costs associated with using the Detroit-Lincoln plant versus building a new engine plant. His counterargument demolished McNamara's assumptions. The committee agreed with Harder that further pursuit of the Detroit-Lincoln plant idea would be "inadvisable."

Harder then distributed--and read--a new memorandum to the Executive Committee in which he reassured the committee members that the plan they had approved a month earlier had been well formulated [14]. The Facilities Committee, Harder stressed, had carefully developed twenty alternative plans of which he had presented only the four most attractive ones. He reiterated that the committee's

decision to build two new engine plants was sound. Presenting locational data for the two new plants, Harder then asked the committee to make a decision about where the plants would be built. The choices included Detroit, Chicago, and Cleveland and combinations thereof. With these choices Harder also presented cost estimations that included site costs, tax burdens, and freight rates but did not include wage rates and "labor efficiency" figures in each of the cities. As the minutes of the meeting note, discussion then "ensued."

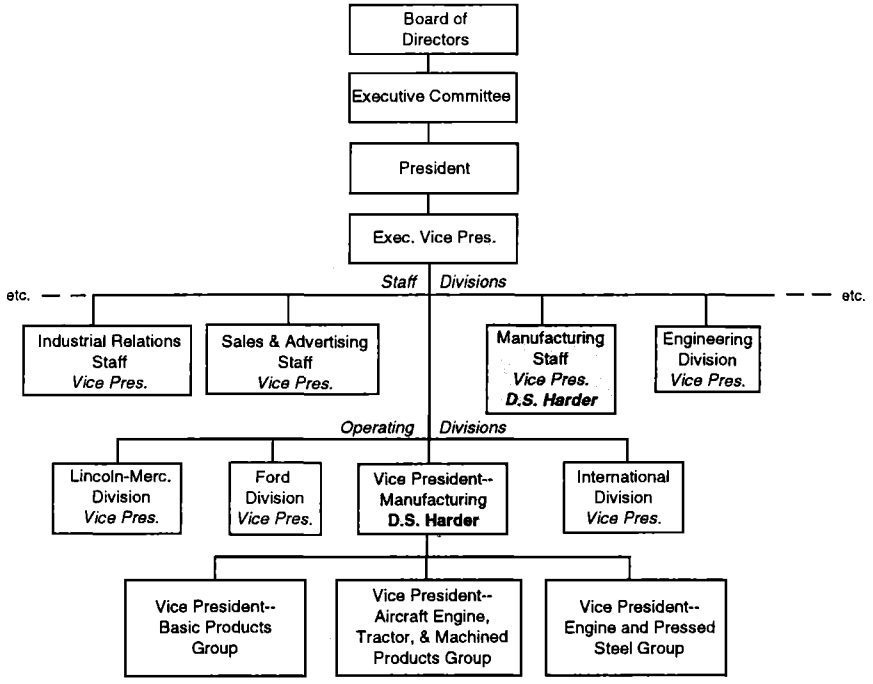
When the meeting adjourned, the committee had determined to build only one engine plant (complete with foundry) and to locate it in Cleveland, Ohio. But unlike either the previously approved plan or McNamara's Plan A, the Cleveland plant would be built to manufacture 4,000 to 4,500 engines a day--essentially the combined daily output projected for the two previously approved plants. Scale economies thus became the overriding factor in the Cleveland plant. "The actual mix of engines to be manufactured in the new plant . . . ," note the minutes, "would be the subject of further study." The decision to build a single plant unquestionably threw out the idea of the product divisions manufacturing their own engines and with it the principle of divisional control of manufacturing assets. The Executive Committee immediately deferred "consideration of the question of whether or not to make the Buffalo Stamping Plant a part of the Ford Division" [8]. Ultimately, the company's decisions about production would lead to the vesting of organizational responsibility for both the Buffalo Stamping Plant and the Cleveland Engine Plant in a "group" of the manufacturing department named the Engine and Pressed Steel Group [9]. (See Figure 5.) Ford Motor Company thus remained production-oriented, rather than product-oriented. The Executive Committee also approved Harder's recommendation to raze the Rouge's old Motor Building and to relocate and upgrade engine production to the Rouge's Parts and Accessories Building.

Although minutes of the Executive Committee's meeting at which it made this major shift in policy survive, they give little or no indication of why executives made this decision. We can speculate, however, that the committee's earlier decision to lessen the company's dependence on the Rouge by fifty percent remained firm and governed the rejection of McNamara's Plan A. But, as noted, the rejection of the two-plant scenario and the decision to build a single engine plant that would produce engines for Ford, Mercury, and Lincoln automobiles clearly signalled that sheer manufacturing efficiency--the Fordist ideal--governed the Ford executives' behavior. The committee's decision to concentrate responsibility for all the company's manufacturing into a big Manufacturing Department demonstrates the pervasiveness and strength of Fordist ideals and the limits of the decentralization theories that had motivated so much of the reorganization that Henry Ford II and Ernest Breech had implemented in the postwar years.

The Executive Committee's decision engendered a great deal of confusion within the ranks of Ford's white-collar employees and its blue-collar workers about decentralization. Led by Ernest Breech, top executives in the company had been espousing the merits of decentralization since 1946 and had waged a campaign to educate the Ford "community" about the principles of decentralized management beginning in May 1947 [23]. At the second of an innovative series of Management Meetings which brought various elements of the Ford Motor Company to headquarters for meetings with top executives, Breech had delivered a thorough briefing on decentralization, much of which was derived from Drucker's *The*

Concept of the Corporation. In subsequent Management Meetings, other top executives briefed their guests about how the concepts of decentralization were being implemented at all levels of the corporation.

FIGURE 5
FORD MOTOR COMPANY ORGANIZATION, MARCH 1951



SOURCE: *Ford Motor Company Annual Report, 1950.*

Yet some members of the company, including its mid- and lower-level managers and especially its blue-collar employees, became confused following the series of Executive Committee decisions to build the Buffalo Stamping Plant, the Cleveland Engine Plant, and the Cincinnati Automatic Transmission Plant. They came to believe that decentralization meant simply de-concentration of the company's manufacture at the Rouge without any evident structural change in the responsibility for the company's manufacturing operations. To a large extent, their perceptions were well founded. By the early 1950s Breech and other top executives

concluded that because confusion in the company about decentralization was so widespread they had to issue a new set of briefings focused on decentralization and to assert that it should not be confused with the erection of plants outside Detroit. Breech, T. O. Yntema (vice president for finance), Delmar Harder (vice president for manufacturing), and John S. Bugas (vice president for industrial relations) all sought to explain how the principles of decentralization--the separation of line and staff functions--had been faithfully executed since 1945 [1].

To understand the Executive Committee's decision not to provide its operating divisions with their own parts manufacturing plants, one must understand the significant development of control systems that had been put in place and were being rapidly expanded by Yntema and especially by Robert McNamara and another Whiz Kid from the Air Force, Arjay Miller. In an interview with McNamara, I queried him about what went on in the Executive Committee meeting that ultimately determined the structure of the Ford Motor Company. Although he could not recall the meeting with any detail, he asserted that the control system he had put in place in the company, and especially the development of transfer pricing, allowed the company to reap the benefits of centralized management of production (hence the Manufacturing Division) while maintaining a semblance of decentralization [18]. He was referring, of course, to the development of the profit center concept and the control and accounting mechanisms that made it possible in an organization like Ford. McNamara also added that many of the Ford executives from General Motors remained so wedded to the General Motors way of doing things that they could not function well in the new Ford organization, which in many respects represented a hybrid of the old Ford Company and the General Motors depicted by Peter Drucker.

Although I have so far explained how the Cleveland Engine Plant played a pivotal role in settling the organizational structure and philosophy of the Ford Motor Company, I have done little to suggest why it came to be seen as such a radical step in manufacturing technology. General Motors figures in this part of Ford's history as well. Three key factors shaped the production operations design of the Cleveland Engine Plant. The first was the decision that Delmar Harder made in April 1947 to organize an Automation Department within his Manufacturing Division [17]. Harder charged the new unit's engineers and production experts with the development of relatively inexpensive, reliable methods of automating the transfer of materials in process from one operation to another. His instructions were to design and install such "automation" devices if the cost of each device were less than $3000 (or roughly ten to fifteen percent over the annual wages of an average, fully employed blue collar worker in the automobile industry at the time). Payback for these devices had to be in one year. Thus, for all intents and purposes, to be viable each automation device had to eliminate at least one worker.

The company's decision in 1949 to build a sheet steel stamping plant in Buffalo gave Harder an enormous opportunity to expand his ideas about automation, and indeed hundreds of automation devices were installed there before the factory opened [22]. That the Buffalo plant was effectively a *tabula rasa* and that it had none of the constraints of labor that existed at the Rouge were fundamental to its success. The thinking behind the Cleveland Engine Plant and its highly automated foundry was definitely influenced by the Buffalo experience; this was the second factor.

The third key factor in the outcome of the Cleveland Engine Plant's design was the Ford Executive Committee's charge to Harder to build a plant in which engines, as is noted in an early planning document, "would be processed without limitation by present practice" [5]. As James Bright recounted the Executive Committee's charge to Harder, the manufacturing engineering department was "to give us the most modern, efficient plant in the country" [2, p. 59]. This was a license to innovate along Fordist lines. Harder moved quickly to push a technology that General Motors had helped to develop while he was there but not aggressively adopted: the transfer machine [16, 20, 29]. The Cleveland Engine Plant would employ transfer machines to a greater extent than any other automobile plant in the world. These transfer machines would be linked together by the materials handling devices of his Automation unit, thereby reducing to almost zero the labor required to load and unload these machines.

Through this design Harder's department largely met the Executive Committee's expectations, and, as already noted, the Cleveland Engine Plant was hailed as an engineering wonder. But almost immediately product obsolescence brought on by the rampant "horsepower race" of the 1950s and '60s pointed up the problems of inflexibility of the "hard automation" at Cleveland [16]. How Ford contended with these problems and whether these problems, as has been frequently been asserted in the last decade or so, were the source of problems for the entire U.S. automobile industry are subjects beyond the scope of this paper.

Without doubt, however, the construction of the Cleveland Engine Plant served to establish the limits on the GM-inspired decentralization movement at Ford Motor Company while also deepening the company's commitment to the Fordist production ideals that had driven Henry Ford and his band of followers when they planned and executed both the bold Highland Park Plant and the gargantuan River Rouge Plant earlier in the century. Fundamentally altering the organizational culture at Ford proved to be far more difficult than Henry Ford II and his mentor Ernest Breech anticipated in 1946.

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