# Industrial morphology

Andre Teissier du Cros

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I'd like to tell you about a method for diversifying products and activities that has been used for 10 years in Europe and is just beginning to be practiced in U.S. corporations.

It all started with the question: "Why diversify?" To answer, let's look at one case. I think it fair to say that one of the most successful and best-known industrial firms in France is Michelin, the tire manufacturer, which pioneered the radial tire. Its volume is No. 2 on the world tire market, and is growing faster than the tire business worldwide. One day François Michelin, the president, was asked why Michelin stubbornly concentrated on a sole, energy-intensive, automobile-dependent market with its frequent crises. He answered: "I am in favor of diversifying investments in order to distribute risks. [But] one must . . . be careful about distributing investments among various businesses and countries, considering each industry to be only one investment opportunity among many. I, for instance, am in the tire business." This was his polite way of saying that his policy was to mind his own business and try to improve it.

I had the opportunity to pursue this discussion with executives from W.R. Grace, which seems able to invest in and control diverse, unrelated firms that range from chemicals to fast food. We spoke just after Grace had divested itself of the French fast-food chain called Jacques Borel, named for its founder. He had been a successful entrepreneur, was expanding, and had recently acquired Sofitel, a French chain of hotels that was experiencing financial difficulties. The Grace representative said: "At Grace we stick to simple rules. If we find a business attractive, we acquire it. We trust existing management, and only require it to provide reliable information on current achievements and future development. If we come to disagree with the management, we sell the company. We sold Jacques Borel because its management wanted to acquire Sofitel. We felt that Borel would not be good at managing a hotel chain, that it was not their style, and that they should stick to their own business."

"Why not fire the chief executive officer in such a case?" I asked. "It would have been against our policy," he answered. "We succeed in controlling unrelated businesses only because we never get involved in the management itself." So Michelin and Grace really agreed.

I later had the opportunity to pursue this subject with Lafarge, the multinational cement firm, which had merged with Coppee, the fertilizer company that did pioneer work in biotechnology. Lafarge had not stuck to its own business. I also spoke with Yamaha, the Japanese musical instrument, motorcycle, and sanitary component manufacturer. I asked

***Table 1.*** **The industrial morphology grid**

| | Option | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| <1 | 1–10 | 10–100 | 100–1000 | 1000–10 000 | >10 000 |
| <1.3 | 1.3–2 | 2–4 | 4–10 | >10 | — |
| <15 | 15–25 | 25–32 | 32–40 | >40 | — |
| >10 | 6–10 | 3–6 | 1.5–3 | 0.5–1.5 | <0.5 |
| <1 | 1–3 | 3–10 | 10–30 | 30–100 | >100 |
| <0.01 | 0.01–0.1 | 0.1–1 | 1–10 | 10–100 | >100 |
| <10 | 10–100 | 100–1000 | 1000–10 000 | >10 000 | — |
| Highly dispersed | Dispersed | Somewhat concentrated | Very concentrated | Monopoly | — |
| Highly dispersed | Dispersed | Somewhat concentrated | Very concentrated | Single client | — |
| None (local) | Weak (domestic only) | Average (some export) | Strong (multinational) | — | — |
| None (commodity) | Weak (furniture) | Average (machine tool) | Strong (pharmacy) | — | — |
| Total (nuts and bolts) | Average (transmission belts) | Weak (computers) | Nil (garments) | — | — |
| Easy | Average (automobile) | Difficult (industrial goods) | Complex (urban transport) | — | — |
| Very high (cigarettes) | High (clothing) | Average (automobile, machine tools) | Low (telephone exchange) | Very low (bridge) | — |
| None or light | Average (automobile) | Important (computer) | Complex (airplane) | — | — |
| Consumable (food) | Short (clothing) | Average (appliances) | Long (machine tools) | Permanent (highway) | — |
| Very high (ball-point pen) | High (electrical appliance) | Average (forklift truck) | Low (computer) | Very low (air control radar) | — |
| <0.1 | 0.1–1 | 1–5 | 5–50 | 50–200 | >200 |
| From stock | On order | Programmed | — | — | — |
| High (jigs and tools shop) | Average | Low (mass production) | — | — | — |
| Low | Average | High | — | — | — |
| One-step process (profile extrusion) | Low (beverage bottling) | Average (electric appliance) | High (telephone exchange) | Very high (diesel engine) | — |
| Individual units | Small runs | Medium runs | Large runs | Mass production | — |
| None (ice cream stand) | Low (hotel) | Average (sheet-metal forming) | High (semiconductors) | Very high (gas turbines) | — |


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What do running a burger joint, making cement, and developing light bulbs have in common? Read on.

**Andre Teissier du Cros**

| Question | Units |
|---|---|
| **Economy** | |
| A. How big is a typical firm? | Typical sales figure (millions of dollars) |
| B. How integrated is the industry? | Sales–purchase ratio: N:1 |
| C. Is it labor-intensive? | Added value per capita (thousands of dollars) |
| D. Is it capital-intensive? | Sales–investment ratio: N:1 |
| E. How expensive is it to be in business? | Minimal access investment (millions of dollars) |
| F. How small is a typical invoice? | Unit price or average invoice (thousands of dollars) |
| **Market** | |
| G. How large is the market? | Market size (millions of dollars) |
| H. Are there many players in the game? | Structure of producer profession |
| I. How many clients do we deal with? | Structure of user profession |
| J. Are they next door, or overseas? | International orientation |
| K. How proprietary is the product? | Strength of brand names, design, patents, etc. |
| L. How standard is the product? | Influence of international standards and regulations |
| M. How easy is access to decision maker(s); how many needed to approve purchase? | Access to decision maker |
| N. How frequently is product purchased? | Frequency of purchase |
| O. How important is after-sales service? | Description of after-sales service |
| P. How durable is the product? | Duration of product life |
| Q. How difficult is it to understand how the product works? | Demonstrability of product or service |
| **Technology** | |
| R. How expensive is a pound of the product? | Value per pound or sales figure per ton ($/lb) |
| S. How is product manufacturing programmed? | Production management |
| T. How self-managed is labor? | Autonomy and initiative left to worker |
| U. Are employees' profiles diversified? | Diversity of employees (skills, sex, culture, ethnicity, etc.) |
| V. How many successive tasks in production process? | Degree of complexity of manufacturing |
| W. Manufacturing: mass-produced or single units? | Production rate |
| X. How important is technological experience? | Degree of technological experience |

Yamaha why and how they had diversified from pianos to motorcycles, which seemed to be very different types of industries (except for the noise, in certain hands). Yamaha answered, "It seemed to be a promising, fast-growing market in which we could use existing resources, and proved to be a familiar business when we got to know it better." Pianos and motorcycles both are manufactured consumer goods sold by specialized retailers to a small segment of the public with a unit price of a few thousand dollars. Lafarge as well found cement and fertilizers both to be capital-intensive, high-volume, engineering-oriented process industries.

It was seeing these unobvious similarities that led us to formulate the concepts of industrial morphology (IM). Its purpose is to identify, in a formal way, what a business is good at and why, and in order to devise tools for business diversification strategies. We call it industrial morphology because our initial experiences showed us that what made two businesses similar or different were shapes and ratios such as:

- one-step or several-step distribution
- capital intensiveness
- a complex manufacturing process with high technical experience.

Such factors condition the experience, competence, and skills of management. For instance, we found that the fast-food and hotel businesses were very different with respect to capital intensiveness. The fast-food business is light in investments. Hotels are as capital-intensive as steel mills. Management skills differ in these two businesses. The capital intensiveness of the hotel business requires long-term planning, quantitative management, and decision-making by consensus, in none of which Jacques Borel had any experience. We saw that cement and fertilizers are similar in capital intensiveness, labor profiles, consumable product type with low value per pound, and are offered to a very dispersed clientele. We started to list and test the criteria that should be taken into account in order to be able to analyze any kind of business. It all started in 1972 when we were three consultants with a government grant, and today the result is what you see in Table 1.

### How it works

The best way to understand how it works is to work up a sample grid. Suppose we want to describe the fast-food franchise business. It looks like Table 2. This is the individual *franchisee's* grid. The *franchisor's* grid will be somewhat different, since we consider a sales figure made up of franchise *revenue*, which may be larger on a national market, with a small number of competitors, etc. Note that our fast-food franchise generally lies on the left side of the

**Table 2. Industrial morphology grid for a fast-food franchis**

| Question | Units | 1 | 2 | 3 |
|---|---|---|---|---|
| **Economy** | | | | |
| A. How big is a typical firm? | Typical sales figure (millions of dollars) | <1 | **1–10** | 10–100 |
| B. How integrated is the industry? | Sales–purchase ratio: N:1 | <1.3 | **1.3–2** | 2–4 |
| C. Is it labor-intensive? | Added value per capita (thousands of dollars) | <15 | 15–25 | 25–32 |
| D. Is it capital-intensive? | Sales–investment ratio: N:1 | >10 | **6–10** | 3–6 |
| E. How expensive is it to be in business? | Minimal access investment (millions of dollars) | <1 | 1–3 | 3–10 |
| F. How small is a typical invoice? | Unit price or average invoice (thousands of dollars) | <0.01 | **0.01–0.1** | 0.1–1 |
| **Market** | | | | |
| G. How large is the market? | Market size (millions of dollars) | <10 | 10–100 | 100–1000 |
| H. Are there many players in the game? | Structure of producer profession | **Highly dispersed** | Dispersed | Somewhat concentrate |
| I. How many clients do we deal with? | Structure of user profession | **Highly dispersed** | Dispersed | Somewhat concentrate |
| J. Are they next door, or overseas? | International orientation | **None** | Weak (domestic only) | Average (some export) |
| K. How proprietary is the product? | Strength of brand names, design, patents, etc. | None (commodity) | **Weak** | Average (machine tool) |
| L. How standard is the product? | Influence of international standards and regulations | Total (nuts and bolts) | **Average** | Weak (computers) |
| M. How easy is access to decision maker(s); how many needed to approve purchase? | Access to decision maker | **Easy** | Average (automobile) | Difficult (industrial good |
| N. How frequently is product purchased? | Frequency of purchase | **Very high** | High (clothing) | Average (automobile, machine tools) |
| O. How important is after-sales service? | Description of after-sales service | **None or light** | Average (automobile) | Important (computer) |
| P. How durable is the product? | Duration of product life | **Consumable** | Short (clothing) | Average (appliances) |
| Q. How difficult is it to understand how the product works? | Demonstrability of product or service | **Very high** | High (electrical appliance) | Average (forklift truck) |
| **Technology** | | | | |
| R. How expensive is a pound of the product? | Value per pound or sales figure per ton ($/lb) | <0.1 | 0.1–1 | **1–5** |
| S. How is product manufacturing programmed? | Production management | From stock | **On order** | Programmed |
| T. How self-managed is labor? | Autonomy and initiative left to worker | **High** | Average | Low (mass production) |
| U. Are employees' profiles diversified? | Diversity of employees (skills, sex, culture, ethnicity, etc.) | **Low** | Average | High |
| V. How many successive tasks in production process? | Degree of complexity of manufacturing | One-step process (profile extrusion) | **Low** | Average (electric appliance) |
| W. Manufacturing: mass-produced or single units? | Production rate | **Individual units** | Small runs | Medium runs |
| X. How important is technological experience? | Degree of technological experience | None (ice cream stand) | **Low** | Average (sheet-metal forming) |

diversification via resource utilization analysis. The idea is that a firm should consider diversification whenever some resources are or will be underutilized by existing businesses.

A mature business provides cash flow that can be reinvested elsewhere. Thus, in the parlance of the Boston Consulting Group, we have a "cash cow," but no "star." The "star" cannot be provided by the firm's market, so it must come from diversification. In this case, IM is absolutely unique in that it describes the potential diversification area by means of a *profile*, which is a comprehensive, accurate specifications list. The profile allows selection from among possible diversification areas. An example of an IM profile converted into a specifications list is shown at right.

This specifications list may be used to evaluate all industrial sectors described in the standard industrial code. When it is, the diversification study group might come up with such things as laser technology applied to welding; medical scanners for tomography; automatic assembly of integrated circuits through tape-automated bonding (TAB) technology; or industrial robots for manipulation of heavy forged parts. The IM grid thus indicates a wide range of possible diversification areas from which a selection is easier to make by consensus, after comparison and discussion.

Here's another case to examine: "Human resources are underemployed. Can these people find work in another activity?" This kind of problem is more and more frequent in Europe, where government incentives are available for reemployment of labor. In such a case, IM takes into account the profile of labor skills and competencies on one axis, and the economic environment and guidelines (tax and wage levels, logistics situation, etc.) on the other.

We might also ask: "What other product could be sold by our distribution network, which suffers from escalating costs and a stagnating market?" In such a case, we concentrate on the profile of marketing experience and capabilities: Do we have a single client or a highly dispersed clientele? How about unit price and after-sales service? We then work up the specifications list of the product to trade in (trading agreement from Europe or Japan, for instance).

Suppose that we have developed original technology for our own products. To what kind of business should that technology be applied? Do we diversify into that business, or do we license out? This problem was presented to us by Honeywell-Bull, the French subsidiary of Honeywell, in order to determine the potential of TAB in industries other than electronic data processing. The TAB process is the upcoming technique for mounting chips on substrates in the manufacture of electronic subassemblies. IM identified several application sectors (such as computers, numerical

***Table 3.*** **Industrial morphology grid of a G.E. division**

| Question | Units | 1 | 2 | 3 |
|---|---|---|---|---|
| **Economy** | | | | |
| A. How big is a typical firm? | Typical sales figure (millions of dollars) | <1 | 1–10 | 10–100 |
| B. How integrated is the industry? | Sales–purchase ratio: N:1 | <1.3 | 1.3–2 | 2–4 |
| C. Is it labor-intensive? | Added value per capita (thousands of dollars) | <15 | 15–25 | 25–32 |
| D. Is it capital-intensive? | Sales–investment ratio: N:1 | >10 | 6–10 | 3–6 |
| E. How expensive is it to be in business? | Minimal access investment (millions of dollars) | <1 | 1–3 | 3–10 |
| F. How small is a typical invoice? | Unit price or average invoice (thousands of dollars) | <0.01 | 0.01–0.1 | 0.1–1 |
| **Market** | | | | |
| G. How large is the market? | Market size (millions of dollars) | <10 | 10–100 | 100–1000 |
| H. Are there many players in the game? | Structure of producer profession | Highly dispersed | Dispersed | Somewhat concentrated |
| I. How many clients do we deal with? | Structure of user profession | Highly dispersed | Dispersed | Somewhat concentrated |
| J. Are they next door, or overseas? | International orientation | None (local) | Weak (domestic only) | Average (some export) |
| K. How proprietary is the product? | Strength of brand names, design, patents, etc. | None (commodity) | Weak (furniture) | **Average** |
| L. How standard is the product? | Influence of international standards and regulations | Total (nuts and bolts) | Average (transmission belts) | **Weak** |
| M. How easy is access to decision maker(s); how many needed to approve purchase? | Access to decision maker | Easy | Average (automobile) | Difficult (industrial goods) |
| N. How frequently is product purchased? | Frequency of purchase | Very high (cigarettes) | High (clothing) | Average (automobile, machine tools) |
| O. How important is after-sales service? | Description of after-sales service | None or light | Average (automobile) | **Important** |
| P. How durable is the product? | Duration of product life | Consumable (food) | Short (clothing) | Average (appliances) |
| Q. How difficult is it to understand how the product works? | Demonstrability of product or service | Very high (ball-point pen) | High (electrical appliance) | Average (forklift truck) |
| **Technology** | | | | |
| R. How expensive is a pound of the product? | Value per pound or sales figure per ton ($/lb) | <0.1 | 0.1–1 | 1–5 |
| S. How is product manufacturing programmed? | Production management | From stock | On order | **Programmed** |
| T. How self-managed is labor? | Autonomy and initiative left to worker | High (jigs and tools shop) | **Average** | Low (mass production) |
| U. Are employees' profiles diversified? | Diversity of employees: (skills, sex, culture, ethnicity, etc.) | Low | **Average** | High |
| V. How many successive tasks in production process? | Degree of complexity of manufacturing | One-step process (profile extrusion) | Low (beverage bottling) | Average (electric appliance) |
| W. Manufacturing: mass-produced or single units? | Production rate | Individual units | **Small runs** | Medium runs |
| X. How important is technological experience? | Degree of technological experience | None (ice cream stand) | Low (hotel) | Average (sheet-metal forming) |

control machine tools, electric appliances, quartz watches, guided missiles, automobiles, and cameras), and estimated how long it would take for the TAB technology to penetrate these markets. The morphology of the TAB machinery manufacturer was worked out. It appeared that the business was too ambitious for Honeywell–Bull, so licenses were granted to ASSUAG in Switzerland, SAAB in Sweden, and are now being discussed in Italy. All this was the result of one assignment for the Corporate Development Group on a technology whose future was in question when we started work in 1975.

What would an original strategy be for a given market? We have seen that IM is a creative way to answer this question. A good checklist might be:

- What is the prevailing morphology in this market?
- What are the threats to this morphology (e.g., too labor intensive, too energy intensive, heavy investment process industry, yielding a commodity for which Eastern countries get incentives)?
- Has anyone developed an original, more competitive morphology? (For example, the fermentation technology for food flavoring products developed by Kyowa Hakko in Japan promises to be capital-cheap.)
- Which of our assets could help the most competitive morphology? (An example of this factor is: "We are No. 1 on the U.S. heating equipment market and could help a foreign firm that has original technology for insulating materials.")
- Which competitive strategies might we encounter and from which competitors?

**An opportunity specifications list**

- The opportunity will be a product manufactured by our present facility, but sold to a new market.
- The volume generated will be $10 million to $30 million in from three to five years, with an added value of at least $100 000 per employee.
- The capital–intensiveness ratio (sales to total investment required to generate sales) will be between 1:1 and 2:1.
- Manufacture of the product will mainly use existing labor and production equipment, plus some technology that provides a competitive advantage. This technology will be new to us, but already in use in other industries. If possible, it will involve the use of a consumable.
- We will acquire or recruit a marketing force experienced with industrial equipment sold to manufacturing industries.
- Sales will include user training and organizational changes that will be provided to clients.
- After-sales services will be a significant factor.
- The price per pound will be between $20 and $100.
- The unit price will be in the $30 000 to $300 000 range.

**What has been achieved with IM?**

IM has been applied to limited problems by a few American firms (Kodak, General Mills, Honeywell, Saint Regis, ITT). Our greatest experience has been in France with French firms. Pechiney Ugine Kuhlmann (aluminum and chemicals) is now familiar with it. Laboratoires Servier (pharmaceuticals) applied IM and selected diversification into the flavor industry, leading to two successful acquisitions (in the U.S. and France). Government agencies such as the French Ministry of Industry have sponsored the application of IM in the form of the RIO computerized network for business opportunities research which now has 40 local offices throughout the country. In Italy, IM has been applied by the large holding company Finmeccanica, which controls, among other firms, Alfa-Romeo, Aeritalia, and Ansaldo. Philips has begun to use it.

Adapted from a lecture before the Commercial Development Association's 1981 meeting in Colorado Springs.

**André Teissier du Cros** directs the Corporate Development Division of Bossard Consultants (919 Third Ave., New York, N.Y. 10022). He was educated in France, where he earned graduate degrees in mechanical and materials engineering. He founded a consulting practice, I. D. Conseil, which was later acquired by Bossard. He is the author of numerous articles and of four books on the role of technology and industrial innovation in the strategic planning process.