Business Administration

Lecture No. 23 : Total Product Strength and Organization/Process of Development

1. Success Rate of Product Innovation and Total Product Strength
2. Research for Finding Innovation Success Factor
3. Total Product Strength and Development Process
4. Total Product Strength and Development Organization

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1. Success Rate of Product Innovation and Total Product Strength

Success of innovation ・・・ success in market

Innovation in the 20th century is influenced by organizational capability.

Innovation success rate as the "batting average"

（research by Garthenfeld、research by Booz Allen & Hamilton）

"Batting Average" in Which an Idea Succeeds As an Innovation

It is about 30 percent. (research by Garthenfeld)
However, it depends on a starting point.

There is much more marketing failure than technical failure.

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Garstenfeld.A 'Management of Research Development' Nihon Keizai Shimbun, Inc.

"Batting Average" in Which an Idea Succeeds As an Innovation

It is one to several tens of cases. (research by Booz Allen & Hamilton)
"Mortality rate" in an early stage is high. (egg of fish)

If based on the start of development stage, it is one to several cases.
(close to research by Garthenfeld)

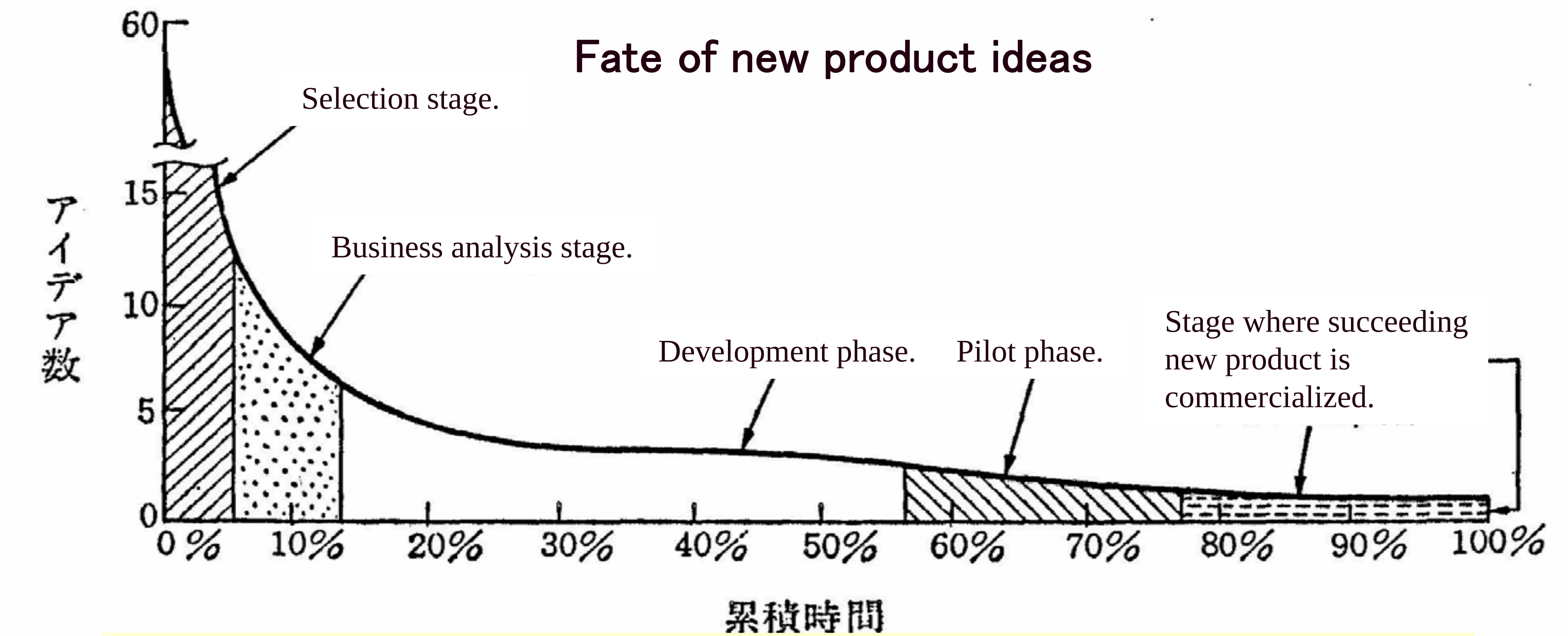


図 2-3 新製品アイデアの運命

D.J.Rack 'Introduction to Product Strategy' DIAMOND,Inc.

How is the qualitative side of development performance measured?

How is the "quality" of a development project measured?

(i) Success and failure of project ･･･
depending on the subjective judgment of person concerned, etc.
(ii) Continuation of company/business ･･･ case of high-tech industry or young industry
(iii) Performance of product･･･ case where product strength can be expressed in objective performance index
(iv) Product cost ･･･ case where product is mature in technology and performance
(v) Index of total product strength･･･ case where product strength is dependent on overall judgment or sensitivity

Case of automobile ： Overall judgment based on design quality, manufacturing quality, share, comprehensive quality, etc.

(Fujimoto/Clark "Product Development Performance")

Evaluation of Total Product Quality(TPQ) of Automobile Development Project

To comprehensive evaluate total quality, manufacturing quality, design quality, and share change.

To influence corporate performance in long run.

(Fujimoto/Clark)

Diagram: Basic data to calculate index for total product quality (TPQ)

1 地域	2 企業	3 総合品質（顧客満足度）			4 製造品質		5 設計品質							6 長期市場占拠率	7 総合商品力指数 (TPQ)
		Consumer Report (1)	Consumer Report (2)	J.D. Powers	J.D. Powers (1985)	J.D. Powers (1987)	concept	styling	perfor-mance	comfort	value for money	overall rank	value-adjusted overall rank		
日本	1	●	●	●	●	●	●	◎	●	●	●	●	●	●	100
	2	◎	●	◎	●	●				◎					40
	3	●	●	●	●	●	◎	◎	◎	◎	●	◎	◎	●	80
	4	●	●	●	●	●	●	●	●	◎	●	●	●	●	100
	5	◎	◎		◎	◎									25
	6				n.a.	n.a.		◎						◎	23
	7	n.a.	n.a.	n.a.	n.a.	n.a.	◎	◎	◎			◎	◎	◎	58
	8	◎	◎	●		●									35
アメリカ	9								◎	●	◎				15
	10			◎	◎				◎	●	◎				24
	11	◎	◎	◎	●	◎	◎	●	◎	◎	●	●	●		75
	12	◎	◎	◎	●	◎	◎	●	◎	◎	●	●	●		75
	13						◎	◎							14
ヨーロッパ量産	14	◎	◎	n.a.	n.a.	n.a.	◎	◎	◎	◎	◎	◎	◎		47
	15	n.a.	n.a.	n.a.	n.a.	n.a.		●	◎		◎	◎	◎		39
	16						◎	●		●		◎	◎		30
	[illegible]	[illegible]					●	●	●	●	◎	◎	●		35
	[illegible]	[illegible]	◎		●		●		●	◎	◎	◎	◎	●	55
	[illegible]	[illegible]	◎	◎	◎	◎	●	●	●	●		●	●		70
	[illegible]	[illegible]	●	●			◎		◎	◎	◎	◎	◎	●	73
ヨーロッパ[illegible]	21	●	◎	●	◎	●	●	●	●	●	●	●	●	●	93
	22	●	●	●	●	●	●	◎	●	●	●	●	●	●	100

Japan
2 companies

Europe
luxury car
2 companies

注：列3－5について：● トップ3分の1　◎ 中位3分の1

列6について：● 長期的シェアアップ　◎ 長期的シェア不変

.資料：藤本・クラーク『製品開発力』ダイヤモンド社。データ収集、指標作成の詳細については、同書を参照されたい。

Standings of Total Product Quality(TPQ) Index (TPQ Index)

Ranking	Hometown region	Score
1	Europe luxury	100
1	Japan	100
1	Japan	100
4	Europe luxury	93
5	Japan	80
6	U.S	75
6	U.S	75
8	Europe luxury	73
9	Europe luxury	70
10	Japan	58
11	Europe mass production	55
12	Europe mass production	47
13	Japan	40
14	Europe mass production	39
15	Europe mass production	35
15	Japan	35
17	Europe mass production	30
18	Japan	25
19	U.S	24
20	Japan	23
21	U.S	15
22	U.S	14

Source：Clark&Fujimoto Product Development Performance, 1991.

2. Research for Finding Innovation Success Factor

- Case study of individual project

- Comparative case study of plural projects

  Peters / Waterman “Excellent Company”
  Imai / Nonaka / Takeuchi, others

- Statistical analysis of large sample

  Myers / Marquis Research (pioneering)
  Project SAPPHO (Sussex University; systematic)

Condition of Excellent Company

(1) Action first (trial and error, embodiment to prototype, experimentalism, principle of individual obliteration, small group, management by walking along work site)

(2) Adhesion to customers (extreme focus on quality/reliability/service, refining customer, joint development with user)

(3) Entrepreneurship (decentralization of decision making, presence of product champion and sponsor, encouragement of inter-company competition with prototype, climate to permit failure)

(4) Productivity improvement derived by positioning which human as asset (innovation of work site, emphasis on training, stable employment, respect of human dignity, productivity increase through human)

(5) Management driven by value concept (leading employees with unofficial corporate philosophy, rather than with formal plans)

(6) Diversification of business related to existing core competence (not aiming at conglomerate, leveraging strength of core business)

(7) Simple and small headquarters

(8) Balance of centralization and decentralization on authority (respect for independence, while intensely centralizing on corporate philosophy)

Reference: Peters & Waterman "Excellent Company"

Major Empirical Researches on Innovation

Source: Portion of this table has been quoted from the end of Table 5.4 in R.Rothwell & V. Walsh (1979) Regulation and Innovation in the Chemical Industry. Reference: Coombes, Sabiottiy, Owulmu "Economics of Technology Innovation" (translation supervision by Takeuchi, Hiromatsu) Shinseisha, 1989, pp114-5

HINDSIGHT: comparative research on extent of each field's contribution by basic science, applied science, and technology to 20weaponry developments, sponsored by US Department of Defense (DoD) (Sherwin & Isenson, 1967)

TRACES: comparative research on extent of each field's contribution by research, development, application that were not based on the military plans, along with the research on the development of 5 innovations primarily based on the military plans, being sponsored by National Science Foundation (NFS) (TRACES, 1968)

Project SAPPHO: comparative research on some combinations of successful innovations and failure ones in chemical industry and material industry; 43 combinations researched (22 for chemical industry, 21 for material industry); success/failure criteria being commercial basis; focus on factors of failures for 34 cases (Rothwell et al., 1974)

The Hungarian SAPPHO: research of 12 combinations of success/failure in Hungarian electrical machinery industry, in a comparative method of SAPPHO combination (Szakasits, 1974)

Carter and Williams: research on characteristics of 200 technically successful companies in U.K. (technically successful companies being defined as ones considered to be close to the best level of management in the period that was achieved by application of science and technology under a certain objective criteria) (Carter and Williams, 1957)

Myers and Marquis: research on features of 567 successful cases of technical innovations in 5 industrial segments in USA (railroad, housing, main framer of computer, computer parts industry) (Myers & Marquis, 1969)

Major Empirical Researches on Innovation (continued)

Queen's Award Study: research on 84 innovation cases that received Queen's Award to Industry for Innovation (Queen's award to industry for innovation) in 1966 – 1969 in UK, analyzing on factors leading to success, and causes delaying innovation (Langrishet al., 1972)

Belgian Study: research for the period of 10 – 15 years on innovation strategies and product policies of 12 Belgian companies, where criteria for success being commercial base (profit increase over 7%) (Hayvert, 1973)

Dutch Study: research in 1966 – 1971 on factors that influenced innovation development capabilities in 45 Dutch companies in metal processing industry, where success criteria being commercial basis, as in the following example to measure relative capability in innovation in a particular industry (Schock, 1974)

「 batting average 」

$$\frac{\text{1971 production of innovation marketed since 1969}}{\text{1971 gross production value}} \times 100$$

MIT Study: research on factors influencing success and failure of innovation in 5 industrial segments (automobile, industrial chemistry, computer, home appliance, textile) in 5 countries (France, West Germany, Holland, Japan, UK), taking up total of 164 actual innovation samples (Utterback et al., 1975)

Textile Machinery Study: analysis on factors which brought about 20 revolutionary innovations and 15 incremental innovations in machinery industry (commercially all successful), with focus on factors leading to 18 failure examples (10 incremental and 8 revolutionary), to include detailed studies on some 20 companies of international samples (Rothwell, 1967a.b)

Gibbons & Johnston Study: comparative research on importance of various information sources including academic community, based on viewpoint to position information as input for innovation process (Gibbons & Johnston, 1974)

Conditions for an Innovation Success（Myers & Marquis）

（1） Accumulation of incremental innovations is important.；

（2） Cognition of potential needs (demand pull) can trigger innovation more easily than that of potential technology (technology push). ；

（3）Introduction and improvement of other company's innovation (adopted innovation) make a similarly important contribution as own company's original innovation.；

（4） External human network is especially important as information sources of an idea about an innovation.;

（5）General public information is unexpectedly important as information sources of technical problem solving.

And, contrary to an idea information, many hints are often available in own company, and an inter-company human network and individual experiences are vital.

（6）Innovation will not be successful without succeeding in all of the three steps which are an idea generation, problem solving, and implementation. Thus the innovation is a work that involves the entire company.

Conditions to Divide Success and Failure of Innovation (Project SAPPHO)

(1) To understand market needs (especially at early stage of development).

(2) Project team to be large

(indication of resource concentration to project)

(3) To Contact with outside groups of scientists directly linked to the subject innovation (not scientists in general)

(4) To place a leader, responsible for integrating the project, with features of a high position, a big authority, high in age, and long in service years

In other words, SAPPHO concludes that conditions for succeeding an innovation are:

to grasp market needs,

to form a strong R&D structure, and

to have a strong inter-company innovator who executes "coupling" of these two factors.

Meanwhile, no particular difference has been observed in terms of an innovation's success or failure with respect to the following factors:

company scale; scale of R&D division;

if an engineer being on the board of directors;

relationship with core business; company's growth rate; company's competitive environment ;length of lead-time

Factor to Affect Innovation Success

Technology push vs. Market pull

・・・In practice, it is relative.

Large company vs. Small company
(monopolistic company vs competitive company)

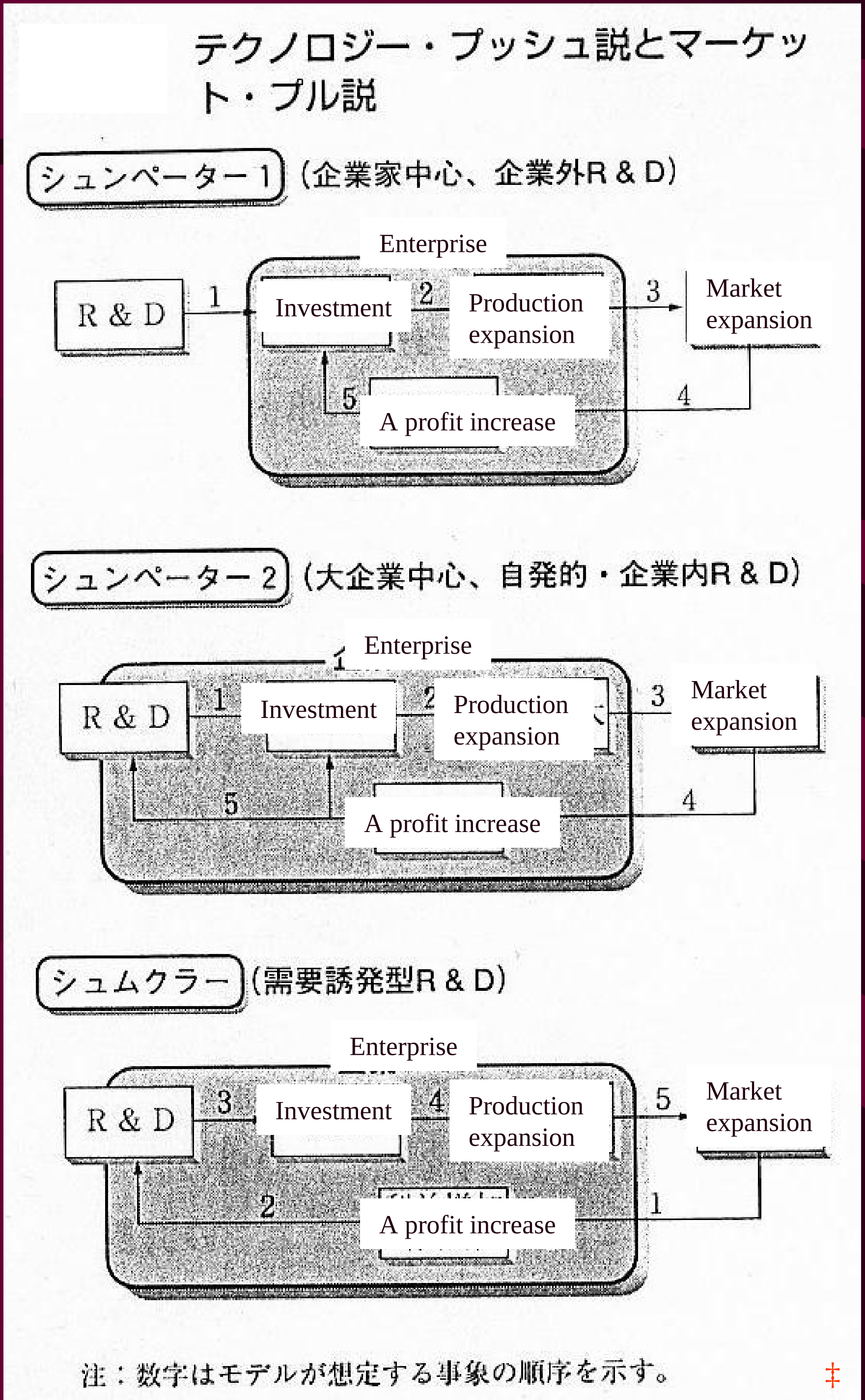
By-function organization vs Project organization

・・・to be described

Technology Push
(e.g., Schumpeter)

vs.

Market Pull
(e.g., Szmukler)

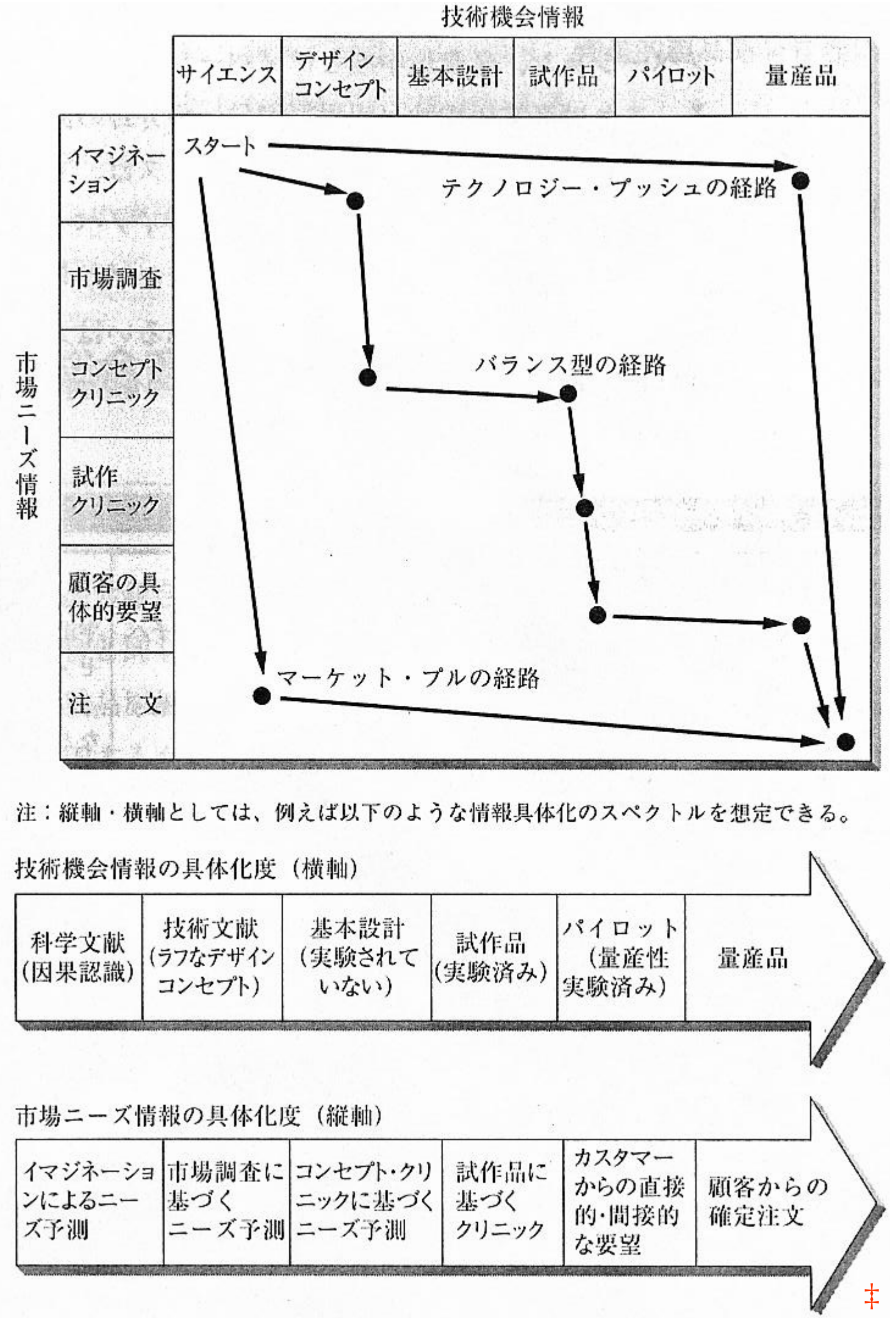


Takahiro Fujimoto 'Introduction to Production Management'
Nihon Keizai Shimbun, Inc. 2001 (Ⅱ 248 figure.16.2)

In fact, there is no black and white question about technology or market.

The market information and technological information become clear in simultaneous parallel.

Technology push and market pull as articulation of information



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Which is good at innovation, a large company or a small company?

Large company's strength and weakness relative to innovation

	強み	弱み	適合産業
大企業	・スケール・エコノミー ・多角化によるスコープ・エコノミー（範囲の経済） （寡占企業であれば、これに加えて資金力、人材、チャンネル支配力）	・イノベーションへのモチベーションが弱い ・組織の官僚化・大企業病	宇宙航空、自動車、染料、医薬、セメント、ガラス、鉄鋼、アルミ、合繊、造船、石炭、ガラスなど（一般に資本集約、装置産業、重化学工業）
小企業	・フレキシビリティが高い ・社内の緊密なコミュニケーション ・R & D、営業、生産の効率的カップリング ・モチベーションが高い（ベンチャー精神） ・低コスト ・リードタイムが短い	・資金力が弱い ・規制対応の能力が弱い ・経営スペシャリストの不足	科学機器、電子、カーペット、繊維、繊維機械、紙パルプ、皮革、はきもの、木材、家具、建築など（一般に機械、軽工業）

No clear-cut answer as conditions affect strong and weak points.

3. Total Product Strength and Development Process

In order to enhance the quality of a project performance, there are two methods:

(i) Building product strength (premise being completion of project)

(ii) Sorting of project

・・・ This logic is similar to that of quality control.

Chain of customer needs' translation : How can this be done accurately?

customer needs → concept → product specification
→ detail design→ process design → process disposition

Grasp of Target Customer Needs

Quantitative market research (stable needs, simple product, quantitative- grasp)

Steady customer interviews (to get accustomed to interviews)

Focus group interview (about ten persons; good efficiency; caution on blind followers)

Thorough on-site observation of market

(observation on streets, etc; developer's own imagination at stake)

Translation to Product Concept

Product concept is, about the product : what it is
what it does
what it means

Expression of concept: visual expression (sketch, model)
linguistic expression
(keyword, statement, scenario)

The problem discovery method of sorting out language data
(new seven tools for QC, cause and effect diagram, others)

To follow customer's voice, or, concept proposal ･･･

depending on customer's capability to grasp own needs.
industrial goods vs. consumer goods

Translation to Product Specification

Ensuring of the concept integrity of product specification

Translation of a keyword
(man-horse unity [Jinba ittai] → tight feeling → sheet size)

Specification should be brief ･･･If all-round, the effect is opposite. (What is important for a customer? Specify priority)

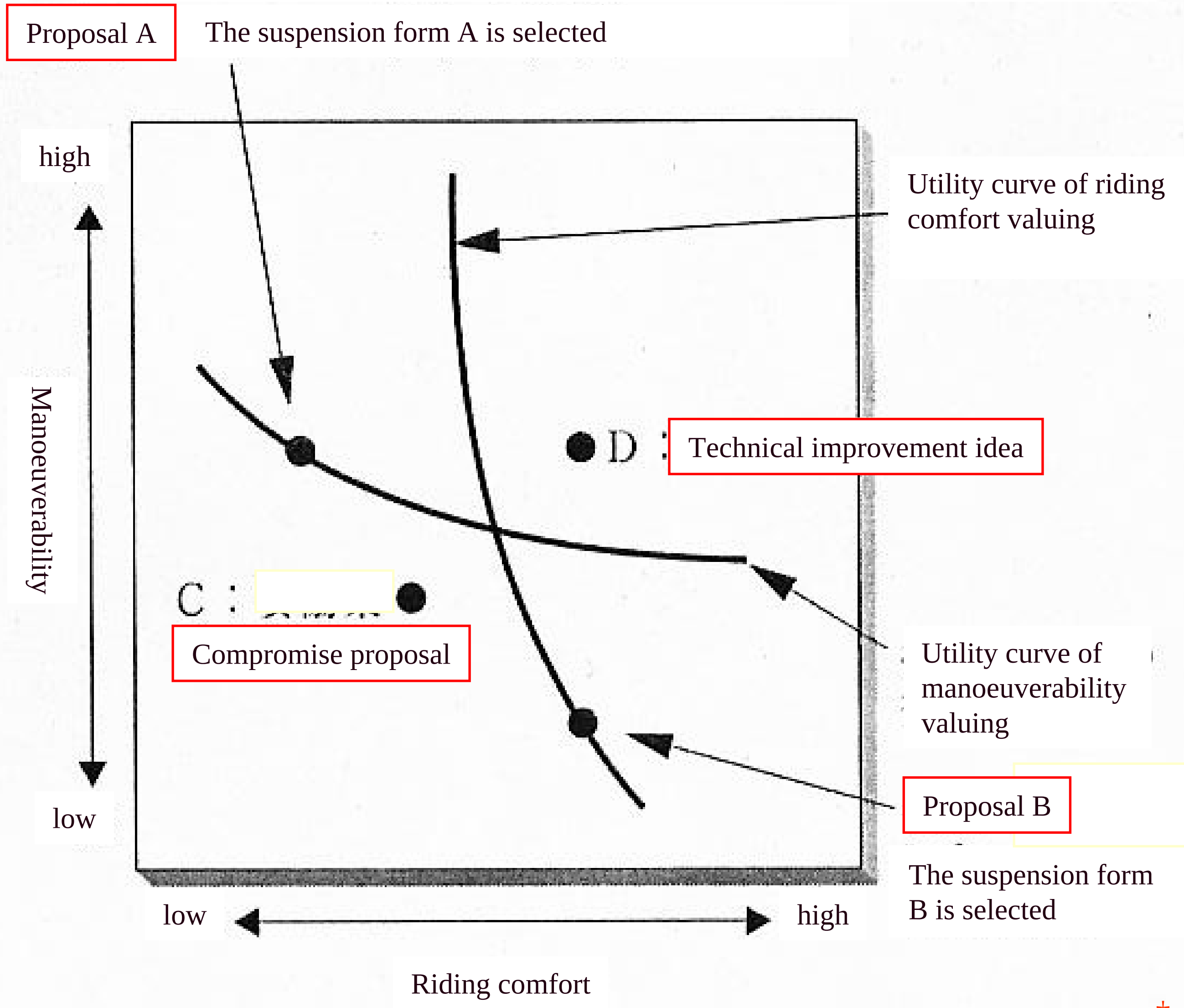
The trade-off conflict between the items of specification ： How to process, and how to overcome?

Compromise ？ Compulsion？ Overcome by technological innovation？

Quality function deployment （QFD）:

Market needs which progressed in Japan
→ Translation tool of product function
Correspondence between customer needs and product specification to be displayed in tabular form (quality table), which promotes an accurate translation.

Specification Determination and Trade-Off Relations (Conceptual diagram)



Takahiro Fujimoto 'Introduction to Production Management' Nihon Keizai Shimbun, Inc. 2001 (Ⅱ 257 figure.16.4)

Translation to Product Design

Design → Trial production → Experiment ･･･Problem-solving cycle

(1) Capability of design : organizational capability of design alternative search
DR (design review) capability

(2) Production capability of trial production/simulation model :
The "degree of actual reappearance" of a trial product is the point.
Cooperation of object trial production section and CAE section

(3) An experiment / simulation capability

Design verification : technological performance evaluation
Design validation : merchantability evaluation

(4) Design change capability :
design improvement proposal, organizational capability of confusion deterrence

Translation to Process Design

Systematic problem-solving capability in process design

- Search capability of process design proposal
- Exact simulation capability in mass production trial
- Flexible manufacturing technological ability (manufacturing for design)
- Conguest of "scale-up problem"

Cost Planning and Target Cost Achievement

Cost planning (target costing)

Target cost ＝ target price − target profit (subtraction method)
Design cost ＝ Σ design cost by parts (accumulating method)

Efforts in development stage to match target cost and design cost ･･･cost planning

VE（Value Engineering） being its means.

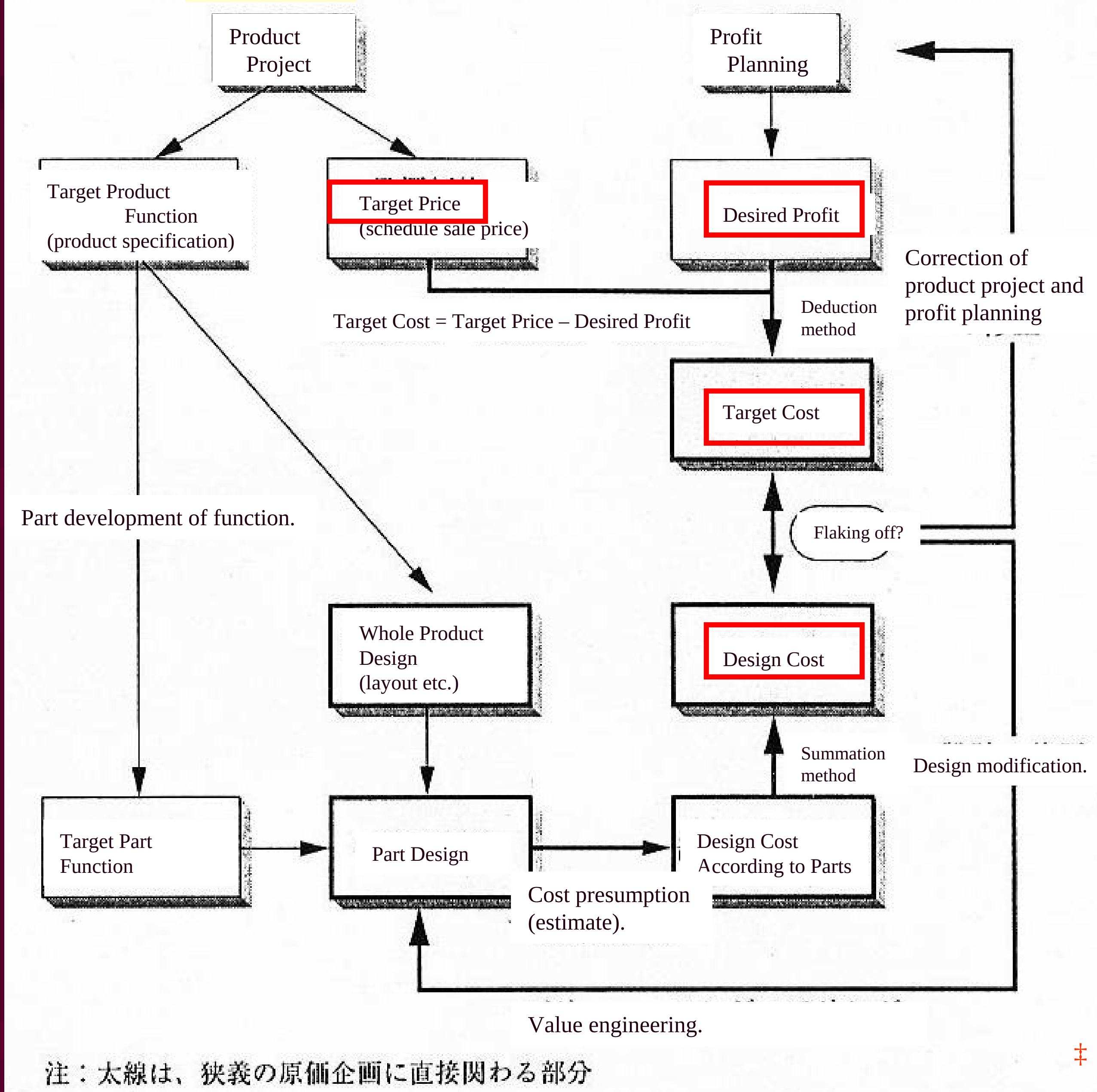
Organization structure of cost planning

Case where a special post has responsibility in cost planning.

Case where a development leader has responsibility in cost planning (examples of Toyota, Nissan).
"The cost planning in broad sense is the product planning/ development itself."

The Process of Cost Planning

Flow of Product Development and Cost Planning



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4．Total Product Strength and Development Organization

Organization by function vs. Organization by project

Organization by function：

○Technological accumulation

●Disadvantageous to integration of product, quick development, and delicate responsiveness

Organization by project：

○integration of product, quick development, and delicate responsiveness

●Disadvantageous to technological accumulation

Matrix organization as intermediate form

By-Function Organization vs. By-Product Organization for Product Development

(i) Characteristics of by-product organization

①This format of organization is adopted by companies which carry a number of products that are different in technological fields or market segments.
②This facilitates a clear-cut responsibility structure in grouping products, and decision-making, direction instruction, information management under a consistent policy.
③Likewise, a uniformity of products becomes better.
④Delicate response to markets and users is possible.
⑤Persons in charge can acquire broad knowledge and experience about products.
⑥On the other hand, their delving in and accumulation of factor technology and specialty technology become weak.
⑦Flexible response to load changes incurred in product development process becomes difficult.

Reference: Takeshi Miyata "Management of Product's Development/Design" Nikkan Kogyo Shinbun, 1995, p154-155

(ii) Characteristics of by-function organization

①This pattern of organization is generally structured by technological field, and is adopted by many companies with strong technological development factors. On the other hand, there is one by phase which is greatly employed in cases where contents or characters of business are different by stage. This has features approximately contrasting to the by-product organization.
②Organization by technological field can provide engineers with deep knowledge and experience as they split each specialty field for all products, and at the same time, standardization and generalization are progressed.
③As responsibilities for product grouping and for execution, promptness in decision-making and problem-solving is difficult, and so is an adjustment of priority among products. Also, a command of investment resources by project becomes difficult.

(iii) Characteristics of matrix organization

①Matrix organization is a combination of the by-product organization and the by-function organization, and is adopted for a case of products with technological variety and complexity, like an automotive development/design, as an example. This organizational format was born with an objective to have merits of the above two patterns.
②However, as there are both types of persons with by-product responsibility and by-function responsibility, the following demerits are likely to accrue:

- time-consuming to adjust policies and opinions between the two parties
- confusion to incur when both give different directions to members
- difficulty in adjustment on selection of members as both parties' interests do not match
- likelihood that evaluation/guidance of members turn our contradictory

機能 / 製品	デザイン	エンジン	車体	懸架	電装
乗用車ﾌﾟﾛｼﾞｪｸﾄ A					
乗用車ﾌﾟﾛｼﾞｪｸﾄ B					
乗用車ﾌﾟﾛｼﾞｪｸﾄ C					
乗用車ﾌﾟﾛｼﾞｪｸﾄ D					

“Heavyweight Product Manager” and Total Product **Strength**

Features of automobile development organization
in Japanese excellent company

(1) Degree of specialization : low

(2) Degree of internal integration : high (adjustment among departments)

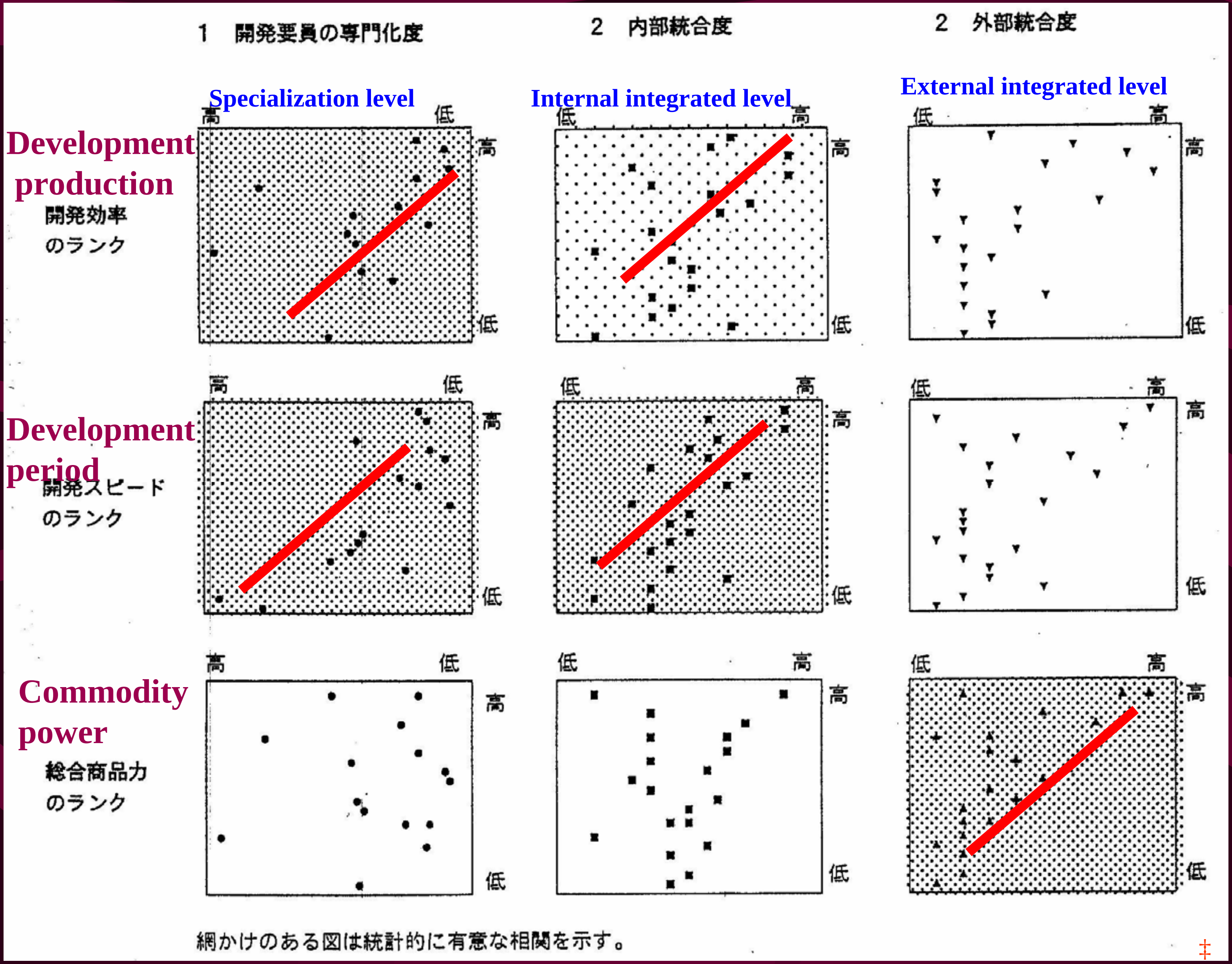
(3) Degree of external integration : high
(linkage with customers through concept)

“Heavyweight product manager” (HWPM) : concept of Clark/Fujimoto

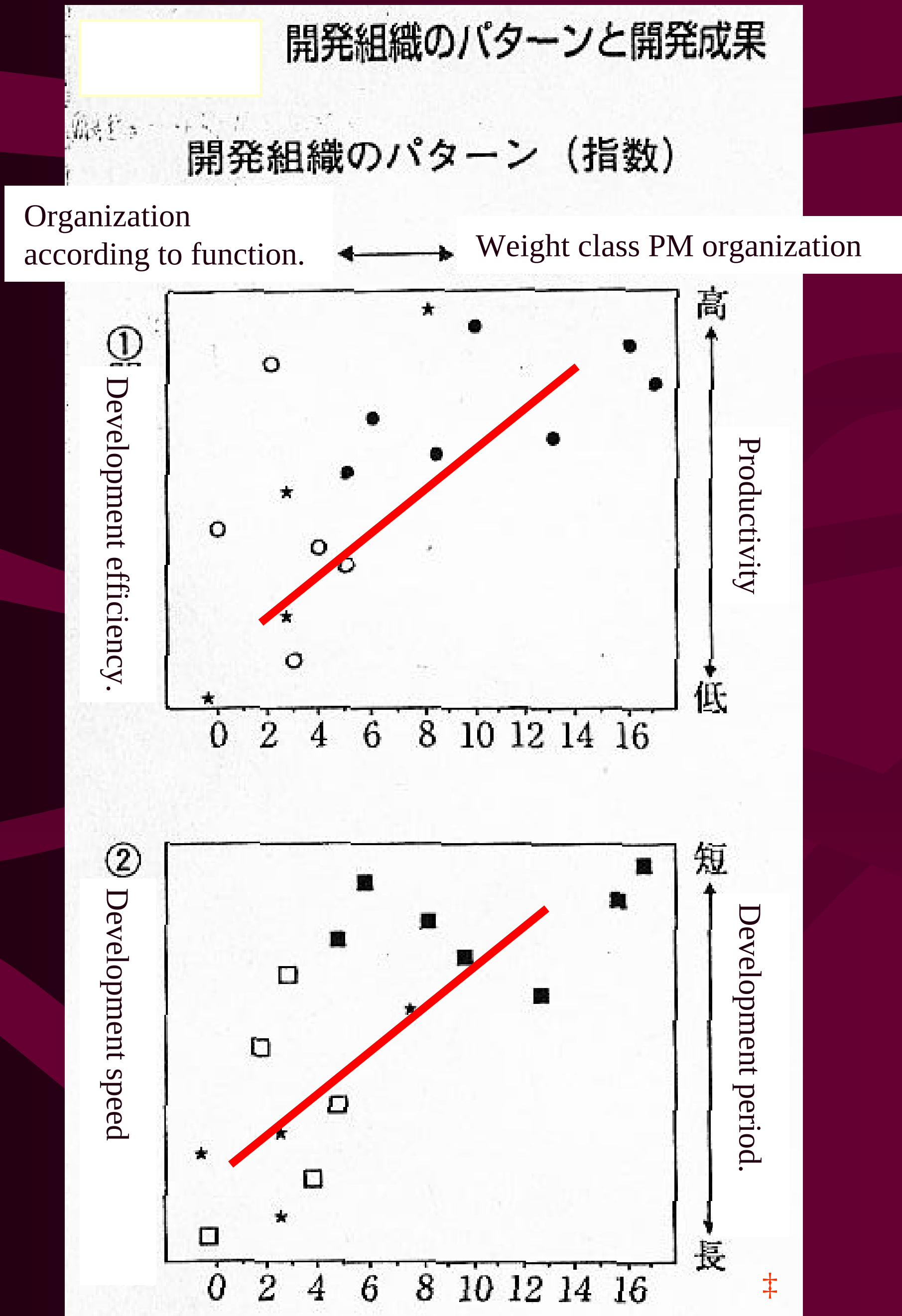
Powerful project coordinator ＋ Powerful concept champion

In 80s, the HWPM organization was superior in all ranges of development period, productivity, and product strength. → introduced to automobile companies around the world.

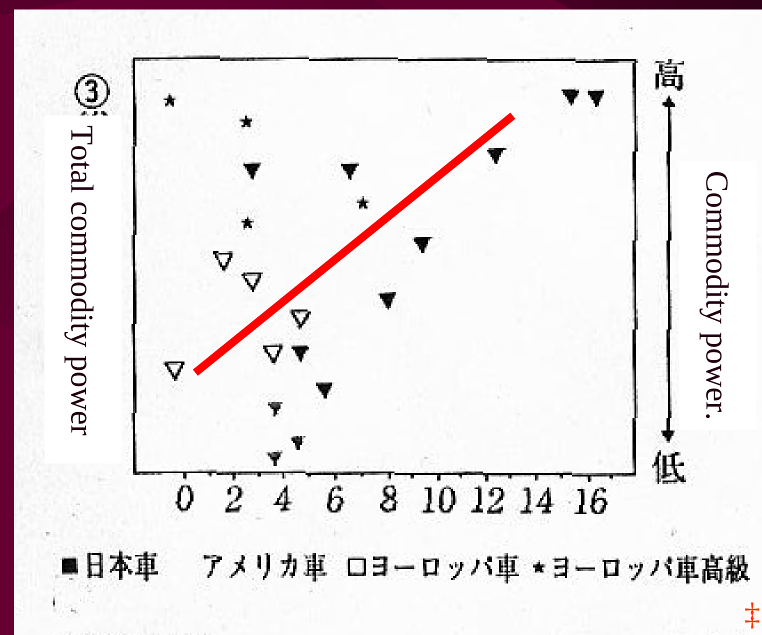
Correlationship Between Degrees of Specialization/Internal Integration/External Integration and Development Performance



Takahiro Fujimoto, Clark K.B. 'Product Development Power' DIAMOND,Inc. 1991



Heavyweight PM being advantageous in all three performance factors of automobile development ･･･grown to the best practice in the world.



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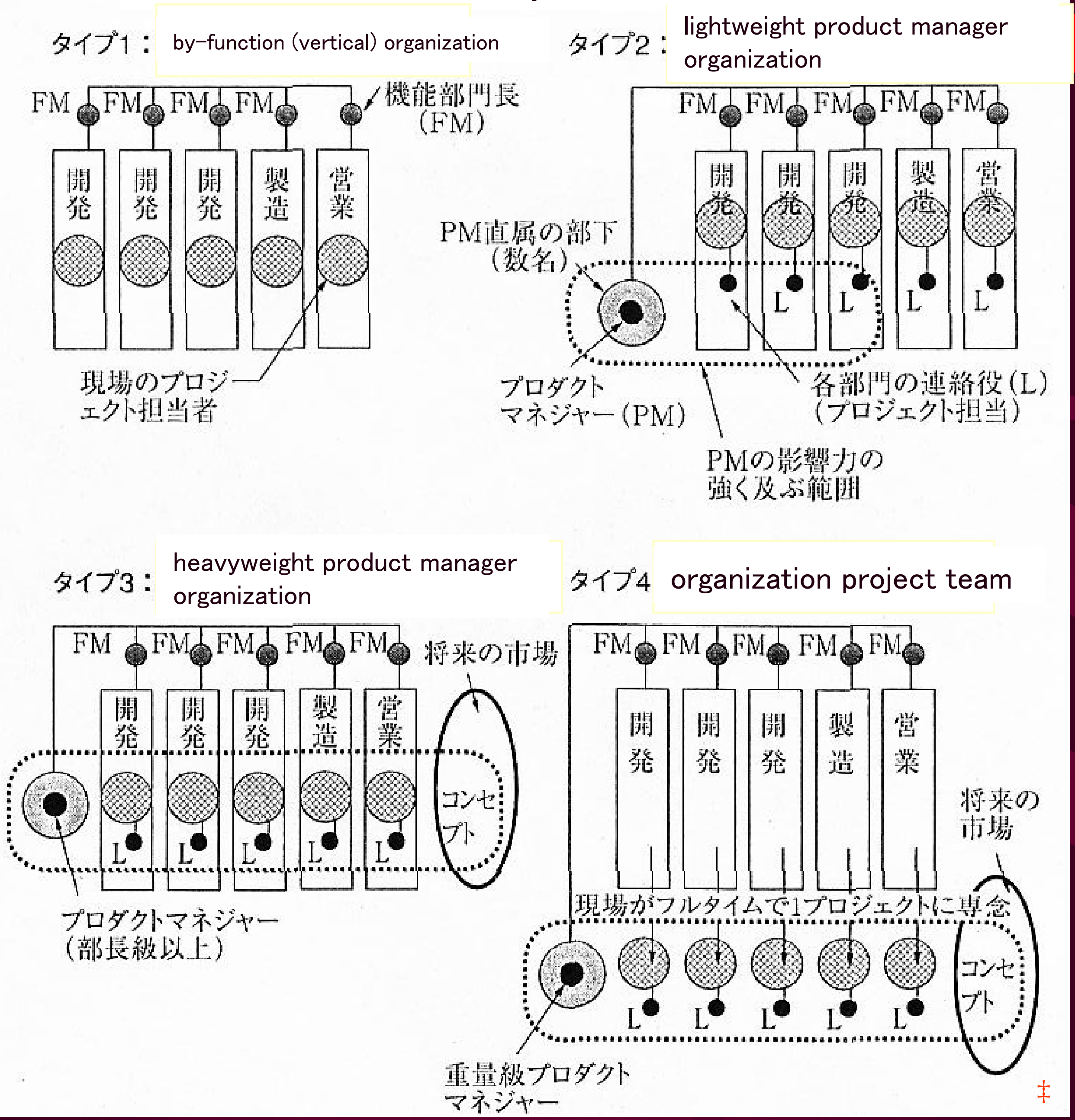
Four Models of Development Organization



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Neither his title nor his rank has anything to do with qualifications of a heavyweight product manager.
Keys are the patterns of his thinking and behavior.

- He is responsible not only for development, but also for adjustments among departments in broad areas including production and sales.
- He is responsible for an adjustment of a project throughout the project's entire period from its conception to market release.
- He also has a responsibility for the concept creation and its crystallization, in addition to adjustments among departments.
- His other responsibilities includes specifications, cost objectives, layouts, and a method selection, etc. for main parts, all of which constitute the means to accurately translate a product concept into technological details in product design.
- He links himself directly with a development site. He secures not just an indirect communication through liaison representing each department, but also a direct and frequent communication with engineers at the level of work site.
- He links directly with customers. That is, apart from periodical quantitative market researches by marketing department, he collects future-oriented market information of his own.
- In order to communicate effectively with staffs in various departments such as design, experiment, factory, and accounting, he is skillful in the "dialect" of each department (multilingual), and is broadly informed of each department's knowledge (multidiscipline).
- He is neither a neutral referee, nor in a passive role of resolving conflicts. He has a determination to initiate battles in order to prevent the product design and plans from deviating from the original product concept.
- He has a capability to translate ambiguous and diversified range of signals out of the current market into a powerful concept, along with one to visualize a future market and to foresee customer needs.
- He prioritizes walking along each department and explaining about the product concept over paper works and formal meetings.
- Majority of PMs are of the engineer origin. They have a broad range of technological knowledge to themselves, if not necessarily deep, regarding to overall automotive technology and production technology.