Lib sc. 2; 1965; PAPER C.

Pragmatic Approach in the Design of a Depth Classification Schedule: A Case Study.*

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[Based on the incidence of (QI) in the subjects going with the (BC) Production Engineering of Internal Combustion Engine, confirms the remarkable usefulness of the Wall-Picture Principle in deriving a helpful sequence among the (QI). Explains where and how the Group Strategy can be adopted in the application of the same Principle. Points out the conditions and restrictions laid down in the idea plane and in the notational plane which call for a careful allocation of the sectors to the (QI). Study of the incidence of the combination of (QI) in 507 (CN) shows that the superimposition of too many (QI) is comparatively rare, that the mode of the curve for the incidence of the combination of (QI) lies between combination of 2 (QI) and that of 3 (QI), and that there are no combinations of more than 11 (QI). After classifying over 600 micro documents in the subject with the provisional schedule, works out a revised allocation of sectors such that over 1,100 digits are saved in the (CN) for 507 documents].

ABBREVIATIONS USED

(AIN)	= Array isolate number	[1P]	= First round personality facet
(BC)	= Basic class	(IP)	= Idea plane
(CN)	= Class number(s)	(QI)	= Quasi isolate(s)
(IN)	= Isolate number(s)		

1 Choice of First Characteristics

Twenty-three First Characteristics—that is (QI)—were found helpful as the basis for the classification of subjects going with the (BC) Reciprocating Internal Combustion Engines [*See* Paper B in this issue]. They were used as the basis for the classification

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of Petrol Engine as well as Diesel Engine as a whole in respect of [1P]. These (QI) were selected by blending the *a priori* and the pragmatic approaches. To begin with some prior general knowledge of the subject was enhanced by reading comprehensive and encyclopædic works, reviews, etc. Seventeen (QI) were thus isolated. After examining current documentation lists on Petrol Engine and Diesel Engine and after consultation with a subject specialist, the following six additional (QI) were found necessary:

Brand	Fuel injection system
Country of make	Starting method
Environment	Size

2 Sequence of the (QI)

21 *A Priori* Approach

In the *a priori* approach, the principle which helps the fixing of the sequence of the (QI) in the (IP) is the ubiquitous Wall-Picture Principle [5]. The sequence of the (QI) thus arrived at is given in column 3 of Table 1 in Sec 221. A provisional pilot classification schedule was drawn up. About 40 recent articles on the subject of Diesel Engine production engineering were classified and the main entries for the documents were arranged by the (CN). The sequence of the Feature Headings and of the terms in the Class Index Entries derived from the (CN) were not quite satisfactory in a few cases. It was, therefore, suspected that the sequence of the (QI) was not correct. One method of checking this would be to classify a large number of micro documents on the subject and find out the sequence of the (QI) as incident in those (CN).

22 Pragmatic Approach

Over 600 micro documents on Diesel Engine production engineering were examined and a random sample of 507 of these published during 1961–64 were classified and arranged. It was felt that a more helpful sequence of the documents would result if the sequence of the (QI) were altered as in column 3 of Table 1 in Sec 221.

221 TABLE 1. SEQUENCE OF THE (QI)

S N	Sequence of the (QI)	
	Original	Revised
1	2	3
1	Brand	Brand
2	Country of make	Country of make
3	Purpose	Purpose
4	Environment	Environment
5	Supercharging	Supercharging
6	Brake horse power	Brake horse power
7	Cycle	Compression ratio
8	Size	Cycle
9	Compression ratio	Size
10	Displacement	Number of cylinders
11	Crankshaft speed	Bore diameter
12	Number of cylinders	Cylinder arrangement
13	Bore diameter	Piston position
14	Cylinder arrangement	Crankshaft speed
15	Piston position	Displacement
16	Stroke distance	Stroke distance
17	Fuel	Fuel
18	Fuel injection system	Fuel injection system
19	Combustion chamber	Combustion chamber
20	Valve type	Valve type
21	Scavenging	Scavenging
22	Cooler	Cooler
23	Starting method	Starting method

23 HELPFULNESS OF THE WALL-PICTURE PRINCIPLE

It may be noted that the more helpful sequence of the (QI) results if only two out of the twenty-three (QI) were interchanged in the sequence obtained first by the *a priori* approach—that is, application of the Wall-Picture Principle.

24 A PROBLEM

The Wall-Picture Principle does not, however, appear to be operative in going from the (QI) 'Cycle' to the (QI) 'Size' and

in going from the (QI) 'Stroke distance' to the (QI) 'Fuel'. We need more experience with such cases where this Principle is not apparently operative in order to arrive at finer methods of applying the Principle or, if necessary, to evolve other principles applicable in such instances.

241 ANNOTATION

1 It may, however, be noted that the (QI) group themselves into three major groups marked off by the (QI) between which the Wall-Picture Principle does not appear to be operative. The three groups are:

Group N	SN of (QI) in col 3, Table 1
1	1 to 8
2	9 to 16
3	17 to 23

Within each group the application of the Wall-Picture Principle gives a helpful sequence of the (QI). We may, therefore, examine whether a helpful sequence can be derived among the three groups of (QI) by the application of the Principle [7].

2 The placing of the (QI) 'By brand' at the head of all the other (QI) can be justified on the basis of two principles. When a Reciprocating Internal Combustion Engine is given a Brand Name, its characteristics are particularised or specified pinpointedly. In other words, it may be possible and even necessary from the point of view of the Canon of Concomitance and the Law of Parsimony to omit recognition of several other (QI) when the (QI) 'Brand' is given in a subject.

Secondly, because the characteristics of the engine become particularised when a Brand Name is given to an engine, therefore it becomes the most concrete subject among the subjects going

with the (BC) Reciprocating Internal Combustion Engine. The arrangement of the documents or the main entries for them should preferably be in the sequence of Increasing Concreteness [4] which is equivalent to the Principle of Decreasing Concreteness in Facet Sequence. This is just what is secured by the Principle of Inversion [6]. The documents in which the Engine with Brand Names are dealt ith will arrange themselves after all the documents on subjects dealing with the Engine without Brand Names.

3 In Group 2 headed by the (QI) 'Size', the (QI) are all related to 'dimensions and positions'. We may consider that taken together these dimensions constitute the overall dimensions or size of the engine. Arguments similar to those given for placing the (QI) 'By brand' at the head of Group 1 hold good for placing the (QI) 'By size' at the head of Group 2.

4 It will also be noted that the various dimensions of the parts and the positions of the parts of the engine are dependent upon some of the First Characteristics in Group 1. For example, if the Purpose is the use of the diesel engine in a ship, a very high BHP will be required. Consequently a large sized engine may be required. On the other hand, if the engine is to be used in an automobile, a lower BHP and a smaller sized engine are indicated. Thus, the (QI) in Group 2 should immediately follow the Group 1 (QI).

5 The remaining (QI) forming Group 3 automatically come after the Group 2. It may also be noted that the (QI) in Group 3 are related to the working or operational factors of the engine.

3 Allocation of Sectors

31 Propositions

1 The sequence of the (QI) arrived in the (IP) should be retained in the Notational Plane.

2 For the present there are twenty-three (QI) to which sectors have to be assigned, but provision will have to be made to accommodate any new (QI) that may arise in the future.

3 The minimum number of isolates to be enumerated and assigned (IN) is about 400.

4 The Law of Parsimony should be respected wherever possible.

5 Sectors in Zone 1 are to be reserved for Common Isolates, and Organ Isolates of the machine.

32 SECTORS AVAILABLE [3]

With the boundary condition that there shall not be more than one digit in an (AIN) the number of sectors available will be 6 and the number of (AIN) 112. This is obviously inadequate for our purpose.

With the boundary condition that there shall not be more than two digits in an (AIN) the number of sectors available will be 24 and the number of (AIN) 424.

This may appear to be adequate for our purpese. But according to proposition 5 above, the 4 sectors in Zone 1 are reserved for Common Isolates and Organ Isolates. Therefore, the remaining twenty sectors will not be sufficient for our purpose.

Thus, it is necessary to use the one-, two-, and three-digited sectors. With the boundary condition that there shall not be more than three digits in an (AIN), the number of sectors available will be 78 and the number of (AIN) 1,378. This should be adequate for the purpose.

4 Restriction in the Choice of Sectors

41 COMMON ISOLATES AND ORGAN ISOLATES

The 13 sectors in Zone 1 are to be reserved for Common Isolates and Organ Isolates. There will be available then 65 sectors for assigning to the (QI). So far in the pilot classification schedules drawn up for various subjects, there have been not more than twenty-five (QI) in any one of them. In the present case there are 23 (QI). Sufficient number of gaps can, therefore, be left in-between the sectors for interpolation and extrapolation of any new (QI) that may arise in the future.

42 ROMAN ALPHABET AS FIRST SIGNIFICANT DIGIT

The following eight (QI) should, preferably, be each assigned a sector which has the Roman alphabet (cap or small) as the first significant digit. The reason for choice of such sectors is indicated in the following table.

S N	Name of (QI)	Reason for assigning a sector with Roman alphabet as first significant digit
1	Brand	Name of brand to be got by Alphabetical Device
2	Environment	To be mnemonic with available schedule*
3	Brake horse power	Given data in Indo-Arabic numerals to be added to the (IN)
4	Compression ratio	Do.
5	Bore diameter	Do.
6	Crankshaft speed	Do.
7	Displacement	Do.
8	Stroke distance	Do.

* Unpublished schedule.

The above condition restricts the choice of sectors.

43 INDO-ARABIC NUMERAL AS FIRST SIGNIFICANT DIGIT

For convenient use of mnemonics, the following (QI) should preferably be each assigned a sector in which the first significant digit is an Indo-Arabic Numeral (IAN):

S N	Name of (QI)	Reason for assigning a sector with (IAN) as the first significant digit
1	Country of make	(IN) for country to be got by Geographical Device
2	Cycle	Use of mnemonic for numbers of the cycles (*eg* for 4-stroke)
3	Number of cylinders	Use of mnemonic for number of cylinders (*eg* 6 for 6 cylinders)

5 Revised Schedule 1

Keeping in mind the conditions mentioned in Sec 3, 42, 43 and in the preceding paragraph, sectors were assigned to the (QI) as given in column 3 in Table 4 in Sec 531.

51 New (QI)

After examining over 600 micro documents and actually constructing (CN) for 507 documents on Diesel Engine no new (QI) arose for interpolation among the (QI) selected at first.

52 Economy in Notation

The next step was to effect economy in notation. For this purpose, the incidence of the individual (QI) and of the combination of (QI) in the (CN) for the 507 micro documents were studied [1]. Table 2 in Sec 521 gives the frequency of occurrence of each of the (QI) in different combinations in the 507 (CN).

521 TABLE 2. INCIDENCE OF (QI)

S N	(QI)	Incidence	% in 507 (CN)
1	Brand ..	226	44·5
2	Country of make ..	26	5·5
3	Purpose ..	330	65·0
4	Environment	4	0·8
5	Supercharging ..	65	13·0
6	Brake horse power ..	188	37·0
7	Cycle ..	53	9·6
8	Size ..	39	7·7
9	Compression ratio ..	46	8·5
10	Displacement ..	23	4·3
11	Crankshaft speed ..	182	35·9
12	N of cylinders ..	110	22·0
13	Bore diameter ..	158	31·2
14	Cylinder arrangement ..	87	17·2
15	Piston position ..	16	3·1
16	Stroke distance ..	131	26·0
17	Fuel ..	18	3·6
18	Fuel injection system ..	9	1·8
19	Combustion chamber ..	13	2 6
20	Valve type ..	5	1·0
21	Scavenging ..	5	1·0
22	Cooler ..	33	6·5
23	Starting method ..	7	1·4
		1,774	

522 ANNOTATION

1 Fourteen of the (QI) occur more than 24 times and 10 of these over 50 times. Among these 10, the following are some of the (QI) arranged according to the decreasing frequency of their incidence in the (CN):

S N	(QI)	Frequency (%)
1	Purpose ..	65
2	Brand ..	45
3	Brake horse power ..	37
4	Crankshaft sp d ..	36
5	Bore diameter ..	31
6	Stroke distance ..	26
7	No. of cylinders ..	22

2 The above (QI) should each preferably be given one-digited or two-digited sectors.

523 COMBINATION OF (QI)

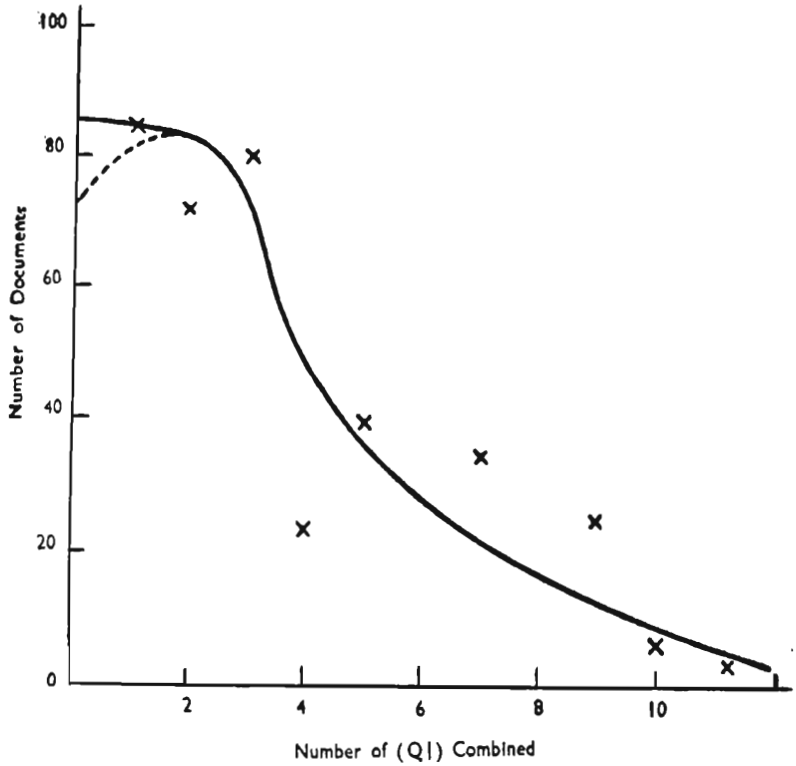
Table 3 in Sec 524 gives the frequency of occurrence of the combinations of (QI) in the 507 (CN).

524 TABLE 3. FREQUENCY TABLE

N of (QI) Combined	N of documents	Progressive total	% of total
0	74	74	15
1	84	158	31
2	73	231	46
3	80	311	61
4	23	334	66
5	39	373	76
6	35	408	81
7	34	442	87
8	29	471	93
9	26	497	98
10	7	504	99
11	3	507	100

525 FREQUENCY CURVE

The following is the frequency curve visualising the above frequency table:



526 ANNOTATION

The frequency curve is ogive. The mode of the curve lies between combinations of 2 (QI) and that of 3 (QI). This implies that the superimposition of too many (QI) is comparatively rare. It is further found that the frequency thins out by the time the combination of 11 (QI) is reached. There is no combination of more than 11 (QI). This is a measure of the state of research in specialised Diesel Engine production engineering. However, each of the 23 (QI) occurs in some document or other. Therefore, schedules should be provided for all the 23 (QI).

53 REVISED SCHEDULE 2

531 TABLE 4. REVISED ALLOCATION OF SECTORS

S N	(QI)	Sector allocated		N of digits gained or lost	Total N of digits gained or lost
		Original	Revised		
1	2	3	4	5	6
1	Brand ..	(ZA)	(ZA)	..	..
2	Country of make ..	(Z1)	(Z1)	..	..
3	Purpose ..	(A)	(A)	..	..
4	Environment ..	(9Z1)	(9A)	+1	+ 4
5	Supercharging ..	(9Z*a*)	(*a*)	+2	+130
6	Brake horse power ..	(9A)	ZZA	+1	+188
7	Compression ratio ..	(99*a*)	ZA	+3	+138
8	Cycle ..	(91)	Z91	+1	+ 53
9	Size ..	(9*a*)	Z9*a*	+1	+ 39
10	N of cylinders ..	(1)	Z1	+1	+110
11	Bore diameter ..	(*z*A)	Z*z*A	+1	+158
12	Cylinder arrangement ..	(*z*1)	*z*Z1	+1	+ 87
13	Piston position ..	(*za*)	Z*za*	+1	+ 16
14	Crankshaft speed ..	(*a*)	A	+2	+364
15	Displacement ..	ZA	9ZA	−1	− 23
16	Stroke distance ..	A	9A	−1	−131
17	Fuel ..	9ZA	99A	..	..
18	Fuel injection system ..	9Z1	91	+1	+ 9
19	Combustion chamber ..	9A	9*z*A	−1	−13
20	Valve type ..	991	9*z*1	..	..
21	Scavenging ..	91	9*za*	−1	− 5
22	Cooler ..	9*a*	9*a*	..	..
23	Starting method ..	1	1	..	..
				1,296	

Net gain = 1,124

532 ANNOTATION

1 The revised allocation of sectors in column 4 above takes into account the conditions mentioned in Sec 3, 42 and 43 and also the number of isolates to be assigned (IN) in each of the schedules.

2 The Law of Parsimony dictates shorter notation for as many of the isolates as possible. This would immediately indicate minimising the choice of sectors from Zones 4, 5, and 6. For, they are all 'packeted' sectors, that is each of the (IN) will have two digits in the form of the connecting symbols—(no semantic value) Starter and Arrester.

3 Now, since the sectors in Zone 1 are not available and as Zones 4, 5, and 6 are to be avoided, there will be available only the sectors from Zones 2 and 3 for allocation. Zones 2 and 3 have 26 sectors. These are to be assigned to the 23 (QI). This means only 3 sectors can be left unassigned for use in case any new (QI) arise in future.

4 Although the Law of Parsimony is apparently satisfied when the choice of sectors is confined to Zones 2 and 3, it will be inadequate provision for the future. The Law of Parsimony should also be examined from another angle. As the universe of Production Engineering of Reciprocating Internal Combustion Engine is a developing subject, there will be need for interpolating new (QI) in the future. Such interpolations of new (QI) may not come up at the points where the gap was left in the initial assignment of the 26 sectors. One may then be obliged to choose from four-digited sectors. This will violate the Law of Parsimony. Further, comfort to memory and comfort to reading will be reduced. If the boundary condition of having not more than three digits in an (AIN) is to be respected, then there may be need for shifting and reallocation of sectors in order to accommodate the new (QI). This may then involve considerable changes in the (IN) in violation of the Law of Parsimony itself. Even if it happens that the three new (QI) that may come up in future just fit into the positions where gaps had been left, to meet the contingency of interpolating any further (QI) that may come up subsequently as the subject develops, the better course would appear to be to leave more gaps even at the outset. In the present case this is not possible by confining the choice of sectors from Zones 2 and 3 only.

5 Further, in the actual allocation of the sectors it was found inconvenient to confine to sectors in Zones 2 and 3 because

of the several restrictive conditions mentioned in Sec 42 and 43.

6 Therefore, some sectors from Zones 4, 5, and 6 were also chosen. This facilitated leaving of more gaps to provide for the interpolation of any new (QI) that may arise. It may be noted that only the one-digited and two-digited sectors (excluding the Starter and the Arrester) from Zones 4, 5, and 6 have been chosen so as to keep to a minimum the number of digits in an (AIN).

7 According to this revised allocation of the sectors the minimum number of digits gained over the original allocation of sectors in the (CN) for the 507 micro documents is found to be over 1,100 (*see* Table 4 in Sec 531).

6 Break-even Point

Although in the 600 documents examined no new (QI) arose it is difficult to look far into the future of the research and development in Production Engineering of Reciprocating Internal Combustion Engine. The problem, therefore, arises as to how big a gap should be left and between what (QI) the gap should be left. Depending upon the number of (QI) isolated in respect of a subject, it will be worthwhile to find out the break-even point in the choice of sectors from the different zones in order to arrive at an optimum economy in providing adequate gaps for the future interpolation of new (QI) and economy in notation for the isolates enumerated in the schedule on hand.

7 Sector Allocation for the Organs

In Sec 31 category 5 above and in the earlier paper on design methodology [3], certain sectors in Zone 1 have been suggested for allocation to the organs. Thus the sectors in Zone 1 are not available for allocation to the (QI) in [1P1]. In Paper B in this issue, the (IN) in the Organ facet, that is [1P2], is preceded by a zero if [1P1] is absent in the (IN). This releases sectors in Zone 1 for allocation to the (QI) in [1P1]. Further, all the sectors in the six zones are available for allocation to the isolates in the Organ facets. That is with

the boundary condition that there shall not be more than 3 digits in an (IN), there will be 78 sectors for allocation to the isolates in the Organ facets. This will be experimented upon in the future schedules for depth classification. With this modification, the reallocation of the sectors to the (QI) in [1P1] (*see* Paper B) results in a further saving of about 400 digits in the (CN) of the 507 documents.

8 Bibliographical References

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2 Sec 32 RANGANATHAN (S R). Design of depth classification: Methodology. (Lib sc. 1; 1964; Sec A4).

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7 Sec 241 —— and NEELAMEGHAN (A). Depth classification of a bibliography. (An lib sc. 10; 1963; Sec D721).