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Tools for Evaluating Service Value

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***Abstract*—This paper describes the development of useful tools to assist managers and engineers to choose between guiding parameters that are either numeric or subjective or both with equal emphasis. Such a procedure can produce a decision support process for service design or product design.**

The technique uses Dimensional Analysis (DA) that is rarely, if ever, used in service science with the method applied to two examples; a wheelchair-mounted robotic feeding arm's computer interface, with choices in data input methods developed via collaboration, (co-creation) with its intended users and to the analysis of a Which™ evaluation for choice of best value cookers, both can be implemented with a spreadsheet.

***Keywords*— subjective decisions, co-creation; value; service dominated logic; dimensional analysis**

I. INTRODUCTION

The shift in focus from manufacturing to a service oriented business demands a change in view and/or theoretical concepts. While Goods-Dominant (G-D) Logic suitably described the manufacturing and production world of the last century, it seems not cater to other aspects of exchange. Another departure from the "older view" lies in the worldview of marketing which evolved from determining optimal organisational performance and defined value in the market place, to customer focus and satisfaction [1]. From the 1980s onwards, the current view of marketing theory and practice encompassed the social and economic process whereby relationship and services marketing is dominated by value proposition ([2], [3]). This proposed paradigm shift paved the way for the current view of Service Dominant Logic ([4], [5]).

One of the early descriptions of value refers to the difference between the customer expectations of service and the perception of the actual service delivered. This has been categorised as service quality but there are different views and forms of measurement, most of which are subjective [6].

Lusch and Vargo [7] define value as "*benefit, an increase in the well-being of a particular actor*" ignoring the cost of achieving that outcome. Parasuraman et al [8] developed the Service Quality (SERVQUAL) model to show potential gaps in services rendered and what is experienced by the customer. In Gap 1, there might be a difference in management perceptions of consumer expectations and the range of customer expected service. In Gap 7, there might be another difference in perception by management and employee regarding customer expected service. This structure clarifies stakeholders' perception and expectation of service encounters identifying service gaps for rectification. SERVQUAL assesses service performance across five dimensions such as "*Tangibles, Reliability, Responsiveness, Assurance and Empathy"* [6] with weighted average scores calculated from the results of questionnaires. Even in this limited retail view of service the prime concern of the customer (user) "that they can expect a certain functionality", is not a central aspect in the paradigm. The SERVQUAL formula is a static review of an interaction, not a dynamic view of the problem. Any co-creator/co-developer has to be effectively brought up-to-speed with the possible beneficial effects of the anticipated service and how to achieve them. This organisation will only attract adherents as long as a "superior" service is not available elsewhere and as with products, will eventually lose out as for example in the case of Netscape which was well used in the 1990s but lost out to Microsoft Internet explorer. This "lock in" phenomena is well known and is exemplified by the case of Betamax versus VHS video formats [9]. In this case Betamax was a superior picture quality technology but offered a poorer service, having significantly fewer customer oriented pre-recorded tapes available for purchase than were available in VHS format.

Cronin and Taylor [10] claimed the alternative SERVPERF model (using 15 item scales), that focussed on actual performance based measurement, worked better than SERVQUAL.

There are also comparative studies of SERVQUAL and SERVPERF measures using their psychometric properties and diagnostic capabilities on service quality gaps to provide insights for managerial intervention [11], [12], [13] & [14]. It is clear from the studies on Medical services, by Wang et al. [15] and on House construction [16] that neither the structures of SERVQUAL and SERVPERF are inadequate for complex systems such as in these two cases. A particular issue was the time interval between when incidents occurred and when the judgement of service was made. Sunindijo et al. [17] stressed that the elements, service quality; reliability; responsiveness; assurance had more importance in the small scale Thai construction industry than for larger international construction projects.

These criteria are not of equal value to the customer and the actions after undertaking a survey such as this can lead to wasted effort for little reward. What is not addressed is how a business could be managed when the outcomes are largely determined by exogenous actors who are not under the control of the companies providing the service. Whenever a large input from diverse users is undertaken, the time involved soon causes project slippage and severe financial costs, good examples here are the defence and software industries [18], [19]. Another consideration is that if large number of users are included, each with differing requirements, the solutions that the company needs to provide becomes multiplex and granular, impossible with the small number of staff available. This is an example of the Law of Requisite Variety [20].

Maglio and Spohrer [21] considered the importance of scientifically understanding value co-creation to enhance the organisation's ability to efficiently, effectively and sustainably, generating profitable design, improving and scaling services accordingly.

Many major manufacturers in Electronics, car and aircraft production now provide an overall service package. Rolls Royce for example, [22] now have a world-wide service organisation monitoring telemetry from working jet engines in real time and organising maintenance and parts. In the software industry focus to reduce failure has been matched by a concentration on the usability of software with development procedures devised to make the developers closer to the users much earlier in the development cycle. This requirement to reduce software failures has resulted in the use of agile development methods, such as Evo [23], which can be described as co-development. Gilb [23] also has developed ways of writing subjective criteria as objective demands using “planguage” and then including this in a business plan.

The aim of this paper is to investigate value co-creation in technologically complex service case where techniques were devised to satisfy the users’ criticism of normal marketing questionnaires; to provide a consistent basis for judgements. The case studies give a simple procedure that can be used in many applications regardless of geographic location and local norms shown by a further application to domestic cooker choice.

II. METHODOLOGY

Eisma et.al. [24] championed the early involvement of the user in the design of assistive and access technology. Many solutions to the problems of universal service remain subjective decisions. However, there are criteria that can be made on numerical values for example; how fast is the response? Our objective was how to produce a decision based on this mixture of subjective and objective attributes. This paper will show how a technique from hard engineering can be adapted for use in such complex service situations. The service examined here is technology dominated as is the use of mobile phone or wearable computing devices.

Interface Design has been the subject of intense investigation for some 30+ years and sets of procedures are used to help with this process [25]. In any development project some method of investigating the response of the subject to a set of design solutions has to be evaluated. Normally a range of service users is chosen and they evaluate the interface and give their subjective assessment of the performance. They may be "experts" in the field or even customers.

In the case of disabled users this choice would be critical since the designers are usually not of the same disability as the users and we do not know *a priori* the capabilities of the user. Clearly a case of co-development, if not co-creation of that service.

The attributes that might yield objective criteria would typically be cost, speed of response, reliability, accuracy or training time, yielding numeric values. Subjective criteria might include accessibility, ease of use, appearance, mental effort required or discomfort. This second set of attributes requires judgement and it is rare that two observers would rate the same solution exactly the same depending on the coarseness of the subsequent quantification. This indicates the robustness problem of comparing objective with subjective judgements. The prime users here did not mention issues with empathy, reporting an excellent rapport with the researcher involved.

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Quality Function Deployment methods [26] are often used where a ranking matrix created with the evaluation weights provided by expert opinion and a weighted average value is obtained to decide on the "best" result as in equation 1. This approach is not robust to expert opinion as in the case where there are a small number of experts, one expert can steer the results with a singular result out of line with all the other experts.

$$Value = \sum_i weight_i * Rating_i \qquad (1)$$

A The dimensional Analysis technique

James Clerk Maxwell [27] introduced the concepts of Mass, Force, Length and Time. He formed them into groups that he called dimensions. Lord Rayleigh first used dimensional Analysis (DA) [28], which was developed further by Buckingham [29]. Every equation must be dimensionally homogeneous [30]. Buckingham further stated that sets of non-dimensional groups can be formed where one non-dimensional (ND) group is a function of a number of other ND groups with that number being dependant on the number of variables and the number of independent dimensions. A simplification that is often used is that they could be expressed as power products (PP), e.g. x^2y^3.

A relevant example here is the use of temperature in Dimensional Analysis. It can be measured in degrees or related to the existing base units mass, length and time. The unit scale is arbitrary and could be divided on any sensible basis. Can we then invent a measure of mental effort, say, that we can devise a value scale for? Before the invention of temperature scales the situation was described as being hot or cold or fairly hot or very cold. This is clearly a scale of values but not specified. In the same way a measurement of mental effort could be devised in terms of the percentage of brain activity.

Langhaar [30] shows that the proof of Buckingham's theorem does not require that the dimensions used to produce the non-dimensional groups have physical significance only that the variables have some definable dependence on them. The dependents can then be reduced to the form of one power law product

In principle then we can mix subjective quantities and measurable quantities in the same formulation provided we use a dimensionless form, subjective values are divided by standard subjective values and the measured values divided by standard measured values.

Braglia and Gabbrielli [31] used a more robust method with a performance index:

Given by:

$$PVI = \sqrt[W]{\prod_i^n \left(\frac{x_i}{s_i}\right)^{w_i}} \qquad (2)$$

With

$$W = \sum_{i=1}^{n} |w_i| \qquad (3)$$

Where the symbol $\prod_i^n$ means the product from *i* to *n.*

Here we have a non-dimensional quantity, the ratio of an attribute to another attribute value, $\left(\frac{X}{S}\right)$ is raised to the power of a weighting *w. The values for all such ratios are multiplied together.*

In this version of a decision criterion, the values of each parameter are compared to a standard value S_i. Each investigation of best service can now be compared using this Performance Value Index and the solutions ranked on this basis. *All such quantities* $\left(\frac{X}{S}\right)$ *are multiplied together and the (absolute sum weighting, W th root) is taken of the product.* The standard value could be chosen on any basis, but here the best value within the trial set was chosen, for example it might be the minimum time to achieve command capture or the lowest price.

B Example A

This example used data from the tests conducted by Parsons [32]. He developed a low-cost robotic arm to assist severely disabled wheelchair users in feeding themselves. The work started in 1988 as a result of collaboration with Robin Platts at the Royal National Orthopaedics Hospital at Stanmore in Middlesex. Funding was provided by the Charity, Association for Spinal Injury Research, Rehabilitation and Reintegration (ASPIRE) and the National Advisory Body (NAB).

As part of the research programme [33] several user interfaces were developed, one of these is shown in figure 1. This could be operated via several types of input; including a normal mouse, a simple switch, a head sensor arrangement that could detect head movements, voice control with commercial software and finally a tracker ball programmed to recognise simple gestures with several disabled users trained to use them. The important parameters for users were: ease of learning, ease of use, mental effort, physical effort, discomfort, error rate, speed of use, appearance and cost.

Three of these: error rate, speed of use, and cost are capable of providing numerical values to judge whereas "experts" normally judge the other parameters. The "experts" were all people with expertise in the field of computer use and disability issues.

User tasks identified were modelled by providing descriptions of the procedures that constituted a task. The descriptions were then refined, using Hierarchical Task Analysis (HTA) decomposing tasks into goals, sub-goals and lower-level actions, allowing for a modular approach to system design.

For this application, user tasks were first described informally by considering how an able-bodied person might undertake the task, or how similar tasks are achieved with existing rehabilitation robotic systems. However, the analysis cannot ensure that the structure identified will optimise the usability of an interface design based on the model. This depends on:

- how accurately the initial task description reflects tasks being undertaken with the manipulator (unknown until the manipulator has been used);
- how frequently and in what order the lower-level actions are performed (effects breadth *versus* depth and ordering of menu options);
- how many, and what type of input devices are employed;
- Form of user interaction employed; etc.

However, as the system was to be designed to be adaptable to specific users, the objective was to allow issues to be resolved for each individual.

Evaluators independently simulated undertaking the user task to achieve desired feeding service by walking through appropriate command sequences with the interface. Aspects of user interaction were recorded that could be deemed as conflicting with the usability heuristics outlined. Separate findings were then pooled and discussed. Where appropriate, a possible solution was suggested to address the level of service required by the users, and an attempt was made to estimate both the severity of the problem, and how difficult the problem would be to address. This allowed for decisions as to whether design modifications should be made, and if so, at which stage of the project's design cycle. As discussed by Neilson [34], problem severity (PS) may be described with two dimensions; impact and frequency. The approach taken here was to construct a Likert scale corresponding to each dimension, allowing for problem severity to be estimated using the product of the average scores given by evaluators.

Estimating the difficulty that may be involved in providing a solution with a cost (SC), was achieved by discussing the amount and type of work involved, ranging from code-editing, and code-development, to investigating a novel solution. An estimation of each usability issue was made of the number of staff-hours required by the producer.

These procedures were reviewed by the users' panel who confirmed the order of priority for the design solutions. Two of these are shown below.

1. *Simple and natural dialogue*. PS = 12, SC = 4. The Stop command returns the user to the top-level menu. However, the user task as modelled suggests it may be more appropriate to be returned to joint selection (the manipulator was a series of rotary joints with links), allowing a number of joints to be more easily moved in quick succession.

2. *Prevent errors*. PS = 5, SC = 1. Currently no confirm command is required before movement of the manipulator commences. A trade-off would be a larger number of commands being issued for each move. The current system does not include a confirm command. However, it would be appropriate to include this as an option when configuring systems.

The system allowed for multiple interface components, sending an input command to a control module, and displaying the current set of possible input commands. This issue was enabled by introducing an additional module referred to as the Dialogue Manager, which activates a control module, in response to a series of input commands

Task analysis identified appropriate modes of control, and provided an outline of the structure of each mode, defined in the user command language.

The parameters considered important by users were; ease of learning, ease of use, mental effort, physical effort, discomfort, and error rate, speed of use, appearance and cost. Three of these: error rate, speed of use, and cost are capable of providing numerical values to judge, whereas "experts" normally judge the other parameters. The "experts" were all people with expertise in the field of computer use and disability issues but not themselves disabled to the same extend as the designed user group.

Parsons [32] gained his assessment by using questionnaires (Table1). The performance was calculated as a percentage of the maximum possible value. No weights were applied. The normal mouse was found to be clearly the winner from the questionnaires but this was challenged by some of the principle users.

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The subjective criteria of interest to users were found by interviewing a range of subjects and by considering how users were evaluated for their rating of electronic products in other tests. In terms of their acceptability for use in the method of DA the criterion that must be used is could they be measured, even if it was a very complex procedure?

The test experts had been involved in the development of the devices, were given 30 minutes training sufficient for them to be able to assess their use as indicated by the debriefing post-test. The training was given to put each expert at roughly the same level since some had not used the devices for some time.

The subjective criteria selected by the users [32] were that the system should be:

"Easy to use

- In principle this is a rating used in many applications; it depends on the time to complete a given task, if the time is excessive, for example if it took over a minute to select an icon to drive the arm to a given position, users would rate this as poor.
- It depended on the number of procedures needed to complete a given task, for example any more than four steps would rate poorly.

Easy to learn

- Here the length of time it took to achieve a given degree of proficiency could be measured.
- If the instructions were clear, the number of mistakes in the learning sequence could be evaluated.

Mental Effort

- The energy consumption in the brain using temperature sensors could be measured,
- The amount of the brain that was active from ECG devices.

Physical Effort

- The energy consumption of a given set of tasks can be measured.

Discomfort

- Although this is more difficult, stress levels using skin sensors and the levels of brain activity could be measured to get a correlation.

Appearance

- This is the most subjective of all the parameters examined, it is affected by colour, feel, layout, style and a whole set of measurements to give an overall rating of appearance has been devised. This was surprisingly important to the users".

These agree very well with attributes tested by other researchers in the Universal Access field [35] but Bates and Instance [36] used a finer breakdown of workload and comfort with little or no improved decision making. Whether this is justified when they are so interrelated is questionable. Other research workers do not consider appearance or cost although the users felt that these were very important to them.

The conventional methods indicated in table 2 are limited in accounting in a quantitative way for the relative merits of cost and performance with subjective qualities such as appearance. A method [37] was devised that could be used for small samples of users, since only small groups of such severely disabled users could be assembled, and which could be used to provide a numerical judgement of qualitative relative properties, ranking these in some way to the hard data that had also been measured.

All five expert value judgements are given in table 3 for the subjective criteria. In order to try and remove the bias due to familiarity with the mouse for example, training for about 30 minutes was given with the devices other than the mouse. Expert A, who still rated the mouse easier than the switch, at variance with ALL other users shows that this did not work completely.

For the new method the experts rate each variable in importance and these values are averaged to give a weighting w_i. The total weighting W is also calculated. The mean value of a variable is divided by the standard and the resulting quotient raised to the power w_i. All these values are then multiplied together as a product and the W *th* root is taken to yield the performance index. It is clear that a wide range of value is still possible and the technique aims to eliminate this by removing the outliers, for example, as in the values for the mental effort using the switch. Generally the assessments are in good agreement.

The important conclusion here is that the rank of the device is altered when the extreme values of judgement are included.

Table 3 includes the raw data for each device with the expert assessments for the subjective quantities. Table 4 shows the weighting values using the Braglia method with the two averages corresponding to the raw average of weights and the second figure is the average after removing the highest and lowest value. In the case of cost the weight is negative. The numbers in the columns are the values of the attributes with the weighting at the bottom of the table. The performance index and thereby the rank appears on the right hand side of the table. The highest value of the performance index gives the best result.

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Costs have reduced significantly since the tests were made and the table could be recalculated with a change in rank depending on how significant price is to the users, emphasizing the need for regular updating of the value function. Standard value for cost by choosing the lowest value of £2 and the standard value for cycle time, 65 seconds, is the lowest value. The parameters used in this case are cost, cycle time to complete 24 operations, the number of error free operations, the relative ease of learning, the relative ease of use, the comfort level, the physical and metal effort required and the appearance. High cost is negatively correlated, as is the cycle time. In both methods a high value of performance indicator is rated higher.

C Example B

In the second example the technique is applied to the choice commercially available goods in this case free standing cookers. Which™ magazine [38] has a substantial record of testing service and products for consumers. In this issue they tested a range of domestic free standing cookers, recommending that the Belling machine was a best buy apparently biased by the overall reliability. The ratings were obtained from a survey of customers. We do not know in this case what questions were actually asked of the Which™ customers.

However consumers base their judgements on a range of parameters. The weights were obtained by the authors from 6 recent purchasers of cookers, independent of the Which™ ratings. They considered what caused them to make their choices, rating price as significant as well as performance and reliability. They rated the opinion of other customers as less reliable. Although they all rated reliability as the highest concern other factors were nearly as important. This may not be the case in the rating given by Which™ [38] as they appear to indicate reliability as the singular factor. Table 5 gives the ratings of perceived value indicator (*PVI*) for the cookers in the Which™ list. In this case the Indesit cooker gives the highest value. This is due to a lower price being factored into the criteria, while the reliability is only slightly poorer. If changes are made to the weightings are made then companies can use the spreadsheet to see how they would have to improve the price/performance to regain market share. The overall test score also needs unpicking to examine what are the clear issues that can be addressed to alter the perceived value to customers as has been achieved with the rehabilitation example.

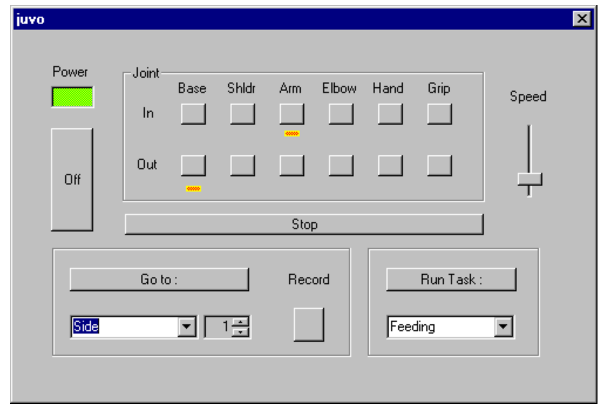

Figure 1 Robotic arm Dialog Interface

III. Relevance

Studies and developments in the field of service science often require the use of both subjective and numeric data. There are a wide range of parameters from accessibility judgements to counts of the number of key strokes to reaction time. This mix of data often presents problems to service researchers and practitioners. To deal with this problem, we presented a techniques based on dimensional analysis. It turns out to be quick and easy to use with a smaller sensitivity to outlying judgements compared with QFD. It also has the benefit that it does not depend on the units of measurement, making it equally relevant in the USA to Europe.

It is certainly true that in service science individual customisation is required, but cost and other factors do not allow a completely free choice of solutions. IT providers too frequently provide only one solution to problems. Users expect a realistic choice and best practice requires that alternative designs are considered [39]. With that in mind it is important that if a small set of users with a range of abilities are consulted, their opinions of different solutions will colour the evaluation process however the technique described here will allow a median choice to be made with all the opinions in or with certain viewpoints removed. This will allow a more robust average view to be gained but can also allow certain views to be selected to enable different sets of opinions to be given precedence by choosing the correct weights. Since it is applicable to testing with small numbers of experts it should encourage developers of novel designs and IT solutions, since divergent opinions will be able to be included or excluded at will.

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IV. Conclusions

The problem that is examined here is the task of assessing service quality considered as an interface between user and service value by analogy with interface design using a mixture of numeric and subjective criteria. The application using Braglia's method is much more robust. Here we have used a technique based on Dimensional Analysis and a mean squares relative performance. It is quick and easy to use with considerable robustness and can be incorporated in data tables in a spreadsheet for example.

The Dimensional Analysis method has the advantage that it does not depend on the units of measurement used as they appear in ratio form. The real difficulty is in deciding whether the subjective parameters could in principle be measured if we took enough effort. Of the variables evaluated subjectively here: ease of use, easy to learn, discomfort, physical effort, mental effort and appearance, only appearance is difficult to gain a numerical value but modern research has shown that a sound basis for such judgements do exist. In this example, we only used five "experts" but the method could be made statistically sound by increasing the number considerably, say to several hundred. This must also be a route to make the evaluation more robust by gaining many more opinions on the ranking of each numeric and subjective variable. It would also be important to lengthen the training period for unfamiliar components to get a true rating compared with familiar items such as a mouse for example.

The vagueness of expert opinion and dependence on the extremes of opinion are diluted. Confidence levels can be significantly improved. Finally, it is less sensitive to the intangible aspects of multi-criteria problems such as selecting between solutions in a complex environment. However, it should be noted that these ratings are not absolute. The values of cost given have changed drastically since the items were purchased and the judgements would change with more training. So as a snapshot of the opinions at a particular time it is clear that in a given timeframe we have a tool to compare different scenarios. Not only can it deal with highly precise measured variables, but with crude or less sophisticated value judgements at the same time.

The basic methodology described here is to use Hierarchical Task Analysis to evaluate via close cooperation with prime users, the service value they require choosing between solutions on the basis of effectiveness and cost of delivery making these choices that are a mixture of objective and subjective information using the Dimensional Analysis procedure.

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List of Symbols

C Cost
DG Dimensionless group
$F1$ Feature
PVI Performance Value index
i Running index
n Number of variables
N_c Non-dimensional cost
N_i Non-dimensional value for ith rating of device j
S_i Standard value of attribute i for device j
V_i Value attributed to ith rating for device j
w_i Weight i
W Sum of individual weights
X_i Attribute i for device j

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Table 1
Input Device Rankings by Questionnaire (data from Parsons 2001).

FUNCTION\DEVICE	Mouse 5	Switch 5	Head 5	Voice 5	Trackball 5
Easy to learn	5	5	4	2	1
Easy to use	5	5	4	3	0
Mental effort	5	3	2	2	1
Physical effort	5	5	3	5	5
Discomfort	5	5	3	5	5
Error Frequency	5	2	3	2	1
Speed	3	2	2	3	0
Appearance	5	5	3	3	5
Mean Performance = $\frac{\sum rankings}{number \quad of \quad attributes}$	**0.95**	**0.8**	**0.6**	**0.625**	**0.45**

Table 2
Attribute Performance Data.

Device		Mouse	Switch	Head Sensor	Voice	Trackball
Objective attributes	**Cost/£**	20	2	60	55	45
	Cycle time/sec	65	109	101	95	300
	Error free moves	24	23	22	19	19
Subjective attributes (set of 5 judgements including outliers)	**Easy to use**	[54455]	[45555]	[54443]	[33442]	[11223]
	Easy to learn	[55545]	[44555]	[44453]	[22233]	[22221]
	Mental effort	[55544]	[25545]	[22232]	[22234]	[11111]
	Physical effort	[55544]	[55545]	[33324]	[55555]	[55555]
	Discomfort	[55544]	[55555]	[33242]	[55555]	[55554]
	Appearance	[44455]	[55555]	[33342]	[33343]	[55555]

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Table 3
Weight Attribute Data from Experts.

Expert	A	B	C	D	E	Mean weight w_i *with[without] outliers*
Cost	5	4	3	4	5	4.2[4.3]
Cycle time	5	5	5	4	5	4.8[5.0]
Error free moves	4	5	5	5	4	4.6[4.7]
Easy to use	4	5	5	5	5	4.8[5.0]
Easy to learn	5	4	4	3	3	3.6[3.7]
Mental effort	4	4	3	4	2	3.4[3.7]
Physical effort	4	4	4	3	3	3.6[3.7]
Discomfort	4	3	4	4	5	4.0[4.0]
Appearance	1	2	2	3	3	2.2[2.3]

Table 4
Rank Table for input devices showing attribute values obtained by Dimensional Analysis, including extreme judgements from Equation 1.

Device/ Attribute	Cost	Cycle time/s	Error free moves	Easy to use	Easy to Learn	Physical effort	Mental effort	Comfort	Appearance	PVI	Rank
Mouse	20	65	24	4.6	4.8	4.6	4.6	4.6	4.4	**0.736**	**2**
Switch	2	109	23	4.8	4.6	4.8	4.2	5.0	5.0	**0.906**	**1**
Head sensor	60	101	22	4.0	4.0	3.0	2.3	2.8	3.0	**0.473**	**4**
Voice	55	95	19	3.2	2.4	5.0	2.6	5.0	3.2	**0.488**	**3**
Trackball	45	300	19	1.8	1.8	5.0	1.0	4.8	5.0	**0.358**	**5**
STANDARD S_i	2	65	24	4.8	4.8	5.0	4.6	5.0	5.0		
Weights w_i	-4.2	-4.8	4.6	4.8	3.6	3.6	3.4	4.0	2.2		
W	35.2										

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Table 5
Free Standing Cooker Rating

BRAND	PRICE/£	TEST SCORE	CUSTOMER RATING	RELIABILITY	PVI
Belling	447	57	64	79	**0.795**
Indesit	292	58	62	78	**0.879**
Zanussi	425	56	64	74	**0.785**
Hotpoint	405	62	56	73	**0.792**
New World	368	63	60	73	**0.825**
Electrolux	441	72	58	63	**0.773**
Stoves	430	65	56	63	**0.754**
AEG	755	82	76	60	**0.724**
Best	292	82	76	79	
Weighting	4	4	3	5	
W	16				