

# Identification and Classification of Parameters for Woodworking Chisel Design

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**Abstract**— The aim of this work is to explore various verbal descriptors associated with manual woodworking chisels based on the literature published online by reputed woodworking chisel manufacturers. Another aim of this study is to identify sets of meaningful factors to which these descriptors could be reduced qualitatively. Verbal descriptors for chisel designs were collected from websites of 38 manufacturers. 4 design experts identified 3 basic kinds of descriptors based on the specific features described within them, namely - (a) descriptions about the blade (71 items); (b) the handle (70 items); and (c) the chisel as a whole (91 items). The experts also identified 3 categories of design-based descriptors, namely - (a) objective descriptions; (b) subjective descriptions, and; (c) descriptions of the performance, benefits or value propositions. Finally, card sorting technique was employed to identify 12 categories of functional domains underlying these descriptors namely - Accessories (A); Branding (B); Configuration (C); Finishing (F); Life (L); Materials (M); Output (O); Purpose (P); Structure (S); Treatment (T); Experience (X), and ; Usability (U). 232 descriptors were finally mapped to the 12 functional categories.

## I. INTRODUCTION

IN today's competitive globalized market and socio-economic paradigm, manufacturers are increasingly interested in continuously monitoring market competition in order to keep their product lines updated with the current trends. The study of product competition has become an important preliminary exercise for any design project. Important insights about what manufacturers consider as important attributes of the product experience such as - unique/special features, value additions, and specific/special customer needs are assessed by comparative benchmarking performed traditionally in marketplaces, and today very often using online resources.

Collecting product-specific data physically from marketplace could be tedious, time consuming, and highly subjective. Researchers often take help of manufacturer descriptions about products using online resources (and, outside of the formal scientific literature) to gain more practical, holistic and contemporary/historical insights about them [1]. With growing digitalization and web access, online mode of primary and secondary research is gaining popularity [2]. Commonly, it is seen that most reputed brand manufacturers and traders maintain official websites which

provide holistic product descriptions and the latest product information.

Product design and research methodologies frequently adopt linguistic approaches inspired by traditions from social sciences in order to gain qualitative insights about user requirements necessary for making decisions about product features. Therefore, verbal description-based surveys are often conducted during user-centred research studies [3]. To cite specific instances of applications, verbal descriptors have been studied in the context of hand tools [4], seats [5], etc.

A popular technique of meaningfully organizing verbal descriptors is card sorting. Card sorting is technique of organizing multiple pieces of information (e.g. verbal descriptors, user perceptions, etc.) into fewer meaningful categories of similar items [6]. Categories are proposed by survey participants and are generally similar in name or in concept. A research team analyzes and combines similar categories to form higher order labels. Open card sorting is used to understand the patterns of how users classify information. Closed card sorting makes use of pre-defined categories supplied to users for assigning cards to them [7].

The product in focus in this study is woodworking chisel. A chisel is a tool of simplicity. The construction is that of a sharpened steel blade attached to a handle. Chisels can be used to split, slice, scrape, chop, and pare wood. They can be held in one hand and driven with a mallet, or be used by two hands for controlled paring cuts. They work equally well with hard or soft wood, almost indifferent to whether they are worked with the grain, across the grain, or on end grain. Bench chisel is one of the most versatile tools inside a woodworking workshop. It is frequently used for dovetailing, mortise-and-tenoning, paring, installing hinges, chamfering edges, and even clean-up of work pieces. Suggestions for chisel selection can be found in various printed and online resources (e.g. [8]-[9]). However, in order to understand essential factors underlying the buying decisions of consumers, and design decisions of manufacturers, it makes good sense that representative opinions regarding chisels from different manufacturers be formally examined. Currently, product reviews, discussion forums, product descriptions available on manufacturers' websites or on e-stores are some good sources to gather contextual information about any product.

One of the reliable sources to gain updated information on manufacturers related design concerns is the data available through product brochures and information available on

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manufacturers' websites. The aim of this study is to compile verbal descriptions about woodworking chisel designs from popular chisel manufacturers' websites and classify them into meaningful factors/categories. These classifications could later be employed for purposes such as developing information architecture of websites, new product development, developing marketing strategies, etc.

## II. PROCEDURE

### A. Online Information on Chisel Designs

An online market research was conducted to explore and understand popular literature on woodworking chisel developed under reputed brands. The list of manufacturers was decided based on inputs from three sources.

The first source was a study conducted in [8] where a comparison of 23 bench chisels was conducted based on the parameters of – (a) the amount of work required to get an out-of-the-box chisel ready for cutting; (b) performance of chisels in paring and dovetail and mortise and tenon joints, and (c) duration the edge held when chopping end grain. 23 brands were compared in this work, namely – *Ashley Isles*, *Ashley Iles American*, *Barr*, *Blue Spruce*, *C.I. Fall*, *Crown*, *Footprint*, *GarrettWade*, *Grizzly*, *Hirsh*, *Irwin*, *Lee-Valley*, *Lie Nielsen*, *MHG*, *Narex*, *Sorby*, *Pfeil*, *Two Cherries*, *Iyoro*, *Grizzly (Japanese)*, *Matsumura (White)*, *Matsumura (Blue)*, and *Nomikatsu*.

The second source for information on popular brands was [9] which provided a comparison of 10 brands of wood working tools on the basis of their – (a) country of origin; (b) edge-holding; (c) slenderness; (d) price; (e) width of range, and (f) availability. The following ten brands were considered – *Pfeil*, *Stubai*, *Carl Heidtmann*, *Mifer*, *Auriou*, *Bristol Design*, *Robert Sorby*, *Ashley Iles*, *Henry Taylor (Acorn)*, and *Marples*.

And as a final source of information, formal discussions were conducted for information on popular chisel brands available in Indian shops. The authors interviewed four woodworking experts employed as technical workshop staff in their department. Suggestion from 8 hardware store owners was also considered. Recommendation for 8 additional chisel brands came up, namely – *Stanley*, *Dewalt*, *Eastman*, *Venus*, *Deeps*, *Taparia*, *Ajay Industries*, and *Black Jack Tools*.

### B. Analysis of Content

Based on a cumulative list of brands compiled from the 3 sources previously, product descriptions were extracted from the official websites of their manufacturers. This list of verbal descriptors was printed and provided to a team of experts constituted of 4 academic researchers (highly experienced Design faculty). The experts as a team were requested to analyze the descriptors and retain only the meaningful and relevant ones. Redundant descriptions were singularized. A reliable list of concise and meaningful product descriptors was created.

A basic classification exercise was then conducted by the

experts to identify descriptions specific to the handle, to the blade, and to the chisel as a whole unit. An additional analysis of the descriptors was conducted to identify a design-centred classification of these items. The experts suggested that this classification could be useful for the purposes of new product development.

### C. Card Sorting

An open card sorting exercise was conducted to identify functionality-centred categories underlying the verbal descriptors set. Chisel descriptors were examined by the 4 experts individually. Each expert was provided a deck of cards with one chisel descriptor listed in each card. The expert had to examine each card and stack functionally related items together in distinct piles. There were no restrictions regarding the minimum or maximum number of items that each pile could consist of. At the end of this process, each expert also had to propose a suitable label for each functional group resulting from this exercise. Later, the experts worked as a team to identify those group labels which were conceptually similar and combined these to create a single category.

A closed card sorting was performed using 16 postgraduate students studying Design. Each of the participants had to analyze every chisel descriptor printed on a card and categorize it under one of the functional groups identified by the experts earlier. The conceptual nature of a typical item to be inserted within each functional group was described to the participants. The cards were organized randomly during card sorting to eliminate perceptual biases. Since, the participants were all postgraduate design students having spent at least 6 years in higher technical education, they had a fairly mature sense of design and manufacturing related concepts. At the same time, the participants were also offered special assistance by the experts when they faced any conceptual concerns associated with the task. Once the exercise was completed, a frequency mapping of the chisel descriptor items was performed against the list of the functional groups identified. This information was rationalized by the 4 experts who then finalized assigning of different descriptor items to specific functional groups.

## III. RESULTS

38 chisel brands were identified for online research. Some of these brands did not have an official webpage. Descriptions on such chisels were collected from reliable alternative web-links, such as the websites of reputed retailers. From the different web sources, it was observed that the following categories of wood chisels were offered by the 38 brands – *bench chisels*, *firmer chisels*, *framing chisels*, *butt chisels*, *carpenter chisels*, *mortise chisels*, and *dovetail chisels*. However, many brands did not manufacture all these varieties of chisels. In order to standardize the context of data collection, product literature was collected for the single most common category of chisel manufactured by most brands which was the 'bench chisel'.

TABLE I  
BLADE DESCRIPTORS.

Code	Descriptor
B01	Access to undercuts like dovetails
B02	Accurate in corners
B03	Bevel edge
B04	Blade guard
B05	Corrosion protection
B06	Cryogenically treated
B07	Cuts straight
B08	Diamond hardness tested
B09	Doubly tempered
B10	Easy to sharpen
B11	Extended life
B12	Extra long
B13	Fine polished
B14	Finely ground
B15	Finely honed
B16	Finished by hand
B17	Flat backs
B18	Flat grounded
B19	Flat tang
B20	Folds into handle
B21	For dovetailing
B22	For easy cutting of harder woods
B23	For manipulations in tight and difficult to access places
B24	Forged by hand
B25	Forged by new unique procedure
B26	Fully forged
B27	Fully grinded
B28	Gets into tight places
B29	Good edge retention
B30	Good rigidity
B31	Good strength
B32	Hardened
B33	High quality
B34	High-holding edge
B35	Highly polished
B36	Lacquered
B37	Laminated
B38	Large tang
B39	Long life
B40	Micro-precise grinding
B41	Minimal friction
B42	Mirror like sheen
B43	Optimum clearance
B44	Parallel sides
B45	Provides sidewall clearance
B46	Provides security
B47	Razor sharp
B48	Reduced risk of blade binding in the cut
B49	Robust forged
B50	Rolling on work surface prevented
B51	Rust resistant
B52	Shaft with through tang
B53	Sharp edge
B54	Sharpened using common abrasive such as water stones
B55	Short
B56	Sides sharpened
B57	Smooth cutting
B58	Smooth face
B59	Superior sharpness
B60	Tang seated deeply
B61	Tapered bevel
B62	Tapered from shoulder to tip
B63	Thin section
B64	Thin sides
B65	Tough
B66	True bevel
B67	Ultra-fine finishing
B68	Unbeatable durability
B69	Unbeatable strength
B70	Wear resistant
B71	Workable in angled corner or tight recess

TABLE II  
HANDLE DESCRIPTORS.

Code	Descriptor
H01	2-part component/bi-material
H02	Asymmetrical profile
H03	Brushed surface
H04	Bulky handle
H05	Cap
H06	Cap withstands repetitive impact/strikes
H07	Comfort in hand
H08	Comfortable gripping
H09	Contoured
H10	Domed end
H11	Durable
H12	Easily replaced
H13	Easy grip
H14	Easy re-seating
H15	Easy to use mallet on end
H16	Easy to use in palm
H17	Elasticity in handle
H18	Ergonomic in hand
H19	Excellent control
H20	Experiencing resurgence in popularity
H21	Extra strength
H22	Extra-large cap
H23	Fatigue free handling
H24	Firm grip
H25	Fits hand nicely
H26	Flat surface
H27	Flats on the top and bottom
H28	For heavy slugging
H29	For paring tools
H30	Hammer button/impact button/strike cap
H31	Handle holds in place
H32	Hardwood handle
H33	Hardwood socket-type handle
H34	High strength
H35	Hole for wall mounting/hanging/suspension
H36	Hornbeam/ Ash/Elm handle
H37	Interchangeable colors
H38	Large striking ring
H39	Longer handle
H40	Loose/not-loose
H41	Natural variation in color
H42	Non-slip handle
H43	Non-slip inserts
H44	Oiled wood
H45	Opening for storage
H46	Precise control
H47	Preferred grip
H48	Refined paring
H49	Resistant to heavy chopping cuts
H50	Resistant to impact
H51	Resists chipping from glancing mallet blows
H52	Robust
H53	Rubber inserts
H54	Shallow flats parallel to the blade back on handle
H55	Shatter resistant
H56	Shorter handle
H57	Simple tap removal
H58	Sits nicely in palm
H59	Socket type handle
H60	Stained handle
H61	Steel striking ring
H62	Strength lies between timber and steel
H63	Tactile cues for finger placement
H64	Tapered version
H65	Toughness
H66	Unbeatable tensile strength
H67	Waxed
H68	Withstands heavy blows from mallet/high impact
H69	Wood from sustainable source
H70	Wood wedged into tapered socket

TABLE III  
COMPLETE CHISEL DESCRIPTORS.

Code	Descriptor
C01	"Hallmark" of guarantee
C02	Accessible packaging
C03	Accurate
C04	Added control
C05	Balances well
C06	Best-in-class
C07	Blade guard
C08	Branded
C09	Brass/steel ferrule
C10	Carpenter's chisel
C11	Centre of gravity below tang-socket connection
C12	Centre of gravity close to the tang-socket connection
C13	Comfortable
C14	Controlled use
C15	Design for craftsmen
C16	Designed by craftsmen
C17	Drop forged
C18	EAN code provided
C19	Easy for customers to evaluate product in store
C20	Easy identification
C21	Elegant gilt-edge taper bolster and ferrule
C22	Ergonomic design
C23	Ever popular style
C24	Expensive
C25	Expensive to make
C26	Favorite of woodworkers around the world
C27	Fine balance
C28	Firmer chisel
C29	Follows DIN 5139 requirements
C30	For carving out a recess with ease
C31	For cleaning up the job
C32	For fine woodworking
C33	For finishing work
C34	For fitting joints
C35	For gentle paring
C36	For guiding with precision and care
C37	For heavy blows
C38	For on-site/jobsite work
C39	For professional construction
C40	For rough jobs
C41	For the most demanding tasks
C42	For traditional cutting
C43	Framing chisel
C44	Free-hand use
C45	Fulfills user need
C46	Handle and blade aligned accurately
C47	Handles are less likely to break
C48	Handles can be replaced easily
C49	Heavy-duty
C50	High/finest quality
C51	Highest standards
C52	Indented mark of brand identity
C53	Innovated design
C54	Integral part of woodworker's toolkit
C55	Leather washer
C56	Light pattern
C57	Made from solid bar stock/blank
C58	Made in Japan
C59	Made in own machine shop
C60	Made of craftsmanship
C61	Manages in restricted working space
C62	Marked with size
C63	Milled
C64	Name you can trust
C65	Not common these days
C66	Once produced in a vast array
C67	Optimal precision as with hand-forged
C68	Popular product/design
C69	Precision made
C70	Professional woodworking
C71	Protects working edges of blade when not in use
C72	Reputed
C73	Resurgence in popularity

C74	Revolving ferrule
C75	Ring ferrule
C76	Short
C77	Should be your first set
C78	Socket chisel
C79	Socket-like stainless-steel ferrule that seats directly onto the shoulder
C80	Solid steel ring for years of dependable use
C81	Strong ferrule
C82	Superb/Excellent balance
C83	Superior performance
C84	Supports light mallet strokes
C85	Tapered version
C86	Traditional
C87	Turned
C88	Unique
C89	Universally used
C90	Versatile
C91	Withstands abuse

The different descriptors extracted for the 38 brands have been provided in Tables I-III. These descriptors were categorized by the 4 design experts into descriptions regarding the blade (Table I), the handle (Table II), and the complete chisel (Table III).

#### A. Design-centred Descriptors

On preliminary examination of descriptors by the team of experts, a tripartite design-centred typology was realized. 3 design-specific categories of chisel descriptors were proposed by the team, namely – (a) objective descriptions; (b) subjective descriptions; and (c) descriptions about the performance, benefits and value information.

The following explanations were provided by the experts in support of this decision –

**Expert 1:** “A good design could be articulated well and finally implemented to satisfaction if we have information regarding both the objective descriptions of the design as well as a multi-perspective subjective understanding of its usefulness.”

**Expert 2:** “A designed artifact serves a utility. Therefore, it makes sense to describe an artifact in terms of its performance during intended use, and in terms of the benefits offered with its adoption and use.”

A block diagram to illustrate the conceptual understanding of this classification scheme is illustrated in Figure 1. The nature of the three categories proposed is limited to design-specific concerns inclusive of the descriptions about performance, benefit and value offerings.

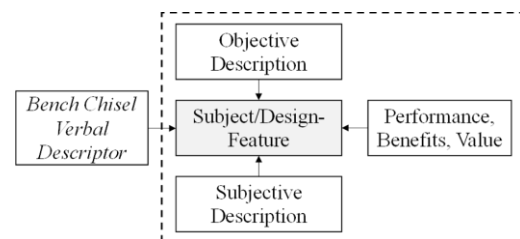


Fig. 1. Deconstruction of a standard descriptor phrase.

The first category of descriptors includes those terms and phrases that provided a fairly objective description of the chisel design. These include information which is not

ambiguous, i.e. clear technical descriptions, as well as undisputed facts about the design. Descriptors in this category includes descriptors such as ‘drop forged’, ‘follows DIN 5139 requirements’, ‘turned from solid blank’, etc.

The second category of descriptors includes terms and phrases which are subjective in nature, i.e. hard-to-quantify, perceived qualities of the subject, or its description. These items include descriptors such as ‘light pattern’, ‘ergonomic design’, ‘shorter handle’, etc.

Several descriptors provided by chisel manufacturers were provided in the form of claims of existence of certain qualities or features in the product. Such descriptors were often provided in the form of a pure subject, i.e. a kind of checkbox item. Such items were treated as value additions as a consequence of their presence - e.g. items like ‘blade guard’ and ‘corrosion protection’ (Table I). Such descriptors also include terms and phrases that provided performance descriptions or benefits offered in the product. This category includes terms such as ‘durable’, ‘free hand use’, ‘fulfills user needs’, etc.

### B. Functionality-centred Descriptors

The tripartite design-centred categorization scheme for classifying chisel design descriptors (Fig. 1) faces the limitation of not being functionally oriented. Therefore, the 4 experts conducted open card sorting and found 12 different functional factors that describe the entire set of chisel descriptors from Tables I-III. The following categories were suggested by the 4 experts, respectively –

**Expert 1:** *Human-centered concerns; Components of chisel; Branding of chisel; Construction details; Fabrication details; Performance of chisel; Structure specific details (7 factors)*

**Expert 2:** *User experience; Tool usability; Chisel assembly; Value offered; Manufacturing information; Material details; Chisel features; Maintenance details; Operation related information; Tool purpose; Form related information (11 factors)*

**Expert 3:** *Aesthetics, sensing and feeling; Design; Accessories; Information; Finishing and processing; Properties; Working and output; Shape (8 factors)*

**Expert 4:** *Subjective information; Configuration related descriptions; Parts and features of chisel; Advantages of the tool; Fabrication details; Material specifications; Maintenance related descriptors; Performance of the tool; Built of the chisel (9 factors)*

A total of 35 categories (factors) were proposed by the 4 experts. But many of these categories conceptually overlapped with each other. Therefore, the experts as a team analyzed and resolved the 35 functional categories into 12 relatively distinct ones. Then, based on the responses of 16 student participants in a closed card sorting exercise, each descriptor item was assigned to a unique functional category if a majority of participants indicated the same during sorting (see Fig. 2). In Table IV, a list of the 12 categories have been provided along with a unique reference code for

each category; the corresponding descriptions about them, as well as the mapping of these factors against the items from Table I-III.

TABLE IV  
TWELVE TECHNICAL FACTORS DESCRIBING THE FUNCTIONAL SPACE OF BENCH CHISEL DESIGN

Functional factor name and reference code	Brief and detailed description of the factor	Codes of descriptors within the group (ref. Tables I-III)
Accessories (A)	<i>Accessories, parts and features.</i> Details about different features and parts of the product.	B04, 38; H05, 22, 30, 38, 43, 53, 61, 63; C07, 09, 55, 74-75 (15 items)
Branding (B)	<i>Branding and information.</i> Advertising pitches and descriptions about special information, quality and value statements.	B24, 33; H18, 20, 47, 69; C01, 06, 08, 15-16, 18, 22-26, 29, 45, 47, 50-54, 58-60, 62, 64-66, 68, 70, 72-73, 77, 86, 88-89 (39 items)
Configuration (C)	<i>Assembly of parts and their configuration.</i> Information on how different parts are fit together, configured and interact with each other.	B60; H40, 70; C46, 79 (5 items)
Finishing (F)	<i>Finishing and construction details.</i> Specific details about the finishing details and special qualities offered due to the construction.	B08, 13-16, 35, 43, 56, 59, 66-67; H03, 21, 31, 60; C11-12, 69, 82 (19 items)
Life (L)	<i>Maintenance and life of the product.</i> Maintenance related information and benefits, and descriptions about life of the product.	B10-11, 39, 54, 68; H06, 11-12, 14, 49-51, 51, 55, 57, 68; C48-49, 71, 80-81, 91 (22 items)
Materials (M)	<i>Materials used and associated properties.</i> Descriptions of materials used, their composition and their properties.	B05, 29-31, 34, 51, 65, 69-70; H01, 17, 32, 34, 36, 62, 65-66 (17 items)
Output (O)	<i>Performance and output.</i> Performance of the product and the output observed on use of the product.	B01-02, 07, 28, 41, 45, 48, 50, 57, 71; H19, 46; C03-05, 14, 30, 61, 67, 83, 90 (21 items)
Purpose (P)	<i>Purpose and context of use suggested.</i> Descriptions or prescriptions about the context of use.	B21, 22-23; H28-29, 48; C10, 30-43, 84 (22 items)
Structure (S)	<i>Structure, shape and size.</i> Details about the physical shape, form and structure of the product.	B03, 12, 17, 19-20, 44, 47, 52-53, 55, 58, 61-64; H02, 04, 09-10, 26-27, 33, 35, 39, 45, 54, 56, 59, 64; C76, 78, 85 (32 items)
Treatment (T)	<i>Processing, treatment and manufacturing.</i> Manufacturing details and information about specific treatment met to the product.	B06, 09, 18, 25-27, 32, 36-37, 40, 49; H44, 67; C17, 57, 63, 87 (17 items)
Experience (X)	<i>Aesthetics and user experience.</i> Descriptions regarding subjective feeling and experiences of users.	B42; H07-08, 23-25, 37, 41, 47, 58; C13, 21, 27, 56 (14 items)
Usability (U)	<i>Product usability.</i> Descriptions about usability-centered design features, and superiority of product during use.	B46; H13, 15-16, 42; C02, 19-20, 44 (9 items)

		Accessories (A)	Branding (B)	Configuration (C)	Finishing (F)	Life (L)	Materials (M)	Output (O)	Purpose (P)	Structure (S)	Treatment (T)	Experience (X)	Usability (U)
B01	Access to undercuts like dovetails	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	75.00%	6.25%	0.00%	0.00%	6.25%	12.50%
B02	Accurate in corners	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	81.25%	0.00%	0.00%	0.00%	12.50%	6.25%
B03	Bevel edge	0.00%	0.00%	6.25%	6.25%	0.00%	0.00%	0.00%	0.00%	87.50%	0.00%	0.00%	0.00%
B04	Blade guard	87.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.25%	0.00%	0.00%	6.25%
B05	Corrosion protection	0.00%	0.00%	0.00%	12.50%	0.00%	81.25%	0.00%	0.00%	0.00%	6.25%	0.00%	0.00%
B06	Cryogenically treated	0.00%	0.00%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	75.00%	0.00%	0.00%	0.00%
B07	Cuts straight	0.00%	6.25%	0.00%	0.00%	0.00%	0.00%	75.00%	6.25%	0.00%	0.00%	0.00%	12.50%
B08	Diamond hardness tested	0.00%	6.25%	0.00%	68.75%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
B09	Doubly tempered	0.00%	0.00%	0.00%	12.50%	0.00%	6.25%	0.00%	0.00%	81.25%	0.00%	0.00%	0.00%
B10	Easy to sharpen	0.00%	6.25%	0.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.25%	37.50%
B11	Extended life	0.00%	6.25%	0.00%	0.00%	93.75%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
B12	Extra long	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	93.75%	0.00%	6.25%	0.00%
B13	Fine polished	0.00%	6.25%	0.00%	93.75%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
B14	Finely ground	0.00%	6.25%	0.00%	75.00%	0.00%	0.00%	0.00%	0.00%	0.00%	18.75%	0.00%	0.00%
B15	Finely honed	0.00%	0.00%	0.00%	93.75%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
B16	Finished by hand	0.00%	18.75%	0.00%	68.75%	0.00%	0.00%	0.00%	0.00%	0.00%	12.50%	0.00%	0.00%
B17	Flat backs	0.00%	0.00%	0.00%	18.75%	0.00%	0.00%	0.00%	0.00%	75.00%	6.25%	0.00%	0.00%
B18	Flat ground	0.00%	0.00%	0.00%	37.50%	0.00%	0.00%	0.00%	0.00%	6.25%	56.25%	0.00%	0.00%
B19	Flat tang	6.25%	0.00%	0.00%	18.75%	0.00%	0.00%	0.00%	0.00%	75.00%	0.00%	0.00%	0.00%
B20	Folds into handle	0.00%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	62.50%	0.00%	0.00%	12.50%
B21	For dovetailing	0.00%	12.50%	0.00%	12.50%	0.00%	0.00%	0.00%	68.75%	6.25%	0.00%	0.00%	0.00%
B22	For easy cutting of harder woods	0.00%	6.25%	0.00%	0.00%	0.00%	0.00%	6.25%	75.00%	0.00%	0.00%	0.00%	12.50%

Fig. 2. Screenshot of a table developed for frequency analysis of participant responses during closed card sorting.

#### IV. DISCUSSION

From the different results, it can be seen that within the chisel literature studied, greatest numbers of descriptions (39) were about *branding and information*. The factor of *branding and information* includes details specific to positioning of the brand and information associated with the product which included value propositions. In online literature, manufacturers keep an important focus on advertising the product and in highlighting the value offerings. This should explain the presence of a majority of such descriptors. Also, a high number of descriptors (32) were related to the *structure, shape and size* of chisels. *Structure, shape and size* constitutes a more utilitarian concern than that of branding. Structure based considerations are probably the most fundamental for any consumer to rationalize its buying decision; which explains the reason for a large number of such descriptions available on manufacturers' websites. The lowest number of descriptors (5) were found for the categories of *assembly of parts and their configuration*, and then for *product usability* (9). Descriptors regarding *assembly, parts and configurations* were the lowest in numbers probably because the bench chisel design typically has very few components. Another reason could be that a number of descriptors regarding chisel components were considered under the category of *accessories, parts and features*. Another factor constitutive of only a few descriptors is *product usability*. Here again, the reason could be the inclusion of usability-related descriptors under other more contextually relevant categories such as *performance and output*, and *aesthetics and user experience*.

#### V. CONCLUSION

In this paper, first a detailed list of verbal descriptors regarding bench chisels was compiled using information published online by manufacturers of 38 popular brands. Initially, using direct observation accounts of 4 design experts, separate lists of descriptors were identified for the blade, the handle, and the chisel as a whole. These experts

later helped in classifying these descriptors on the basis of 3 design-centred categories namely objective, subjective and value-specific descriptions. Finally, using open and closed card sorting techniques, 12 functionality specific categories were identified by the experts and the 232 descriptors captured from online literature were mapped against them.

The authors acknowledge the use of only a limited number of contexts within which the chisel descriptors were examined and the categories were established. It was felt that other kinds of contextual categorization schemes for the bench chisel descriptors could also be explored in the future. Also, categorical schemes proposed in this study could be further examined for their validity across various populations and in different contexts. The descriptors and the categories developed across them in this paper can also be employed as the conceptual grounds for different contextual designs, e.g. better hardware tools for users, superior information architecture for manufacturers' websites, functional divisions within organization, etc.

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