



LEATHERMAN®

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BACKGROUND

BRAND CHOICE

Our mind-map (Appendix A) led us to Leatherman - originator and world's leading manufacturer of high-quality multi-tools, pocket tools and knives.

MISSION STATEMENT

Create innovative products that prepare people for the expected and unexpected, and result in real tales of triumph.

CORE VALUES

The Leatherman values encompass high quality, respect, well-being and the sharing of ideas to foster development.

COMMUNICATION STYLE

The writing style of Leatherman reflects the can-do, confident attitude of the brand by using imperatives, humour, and short, punchy sentences:

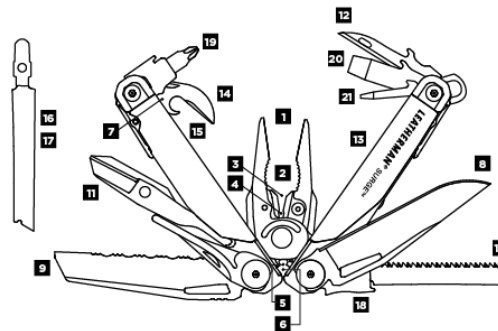


USE OF GRAPHICS

Leatherman primarily uses three types of graphical element for communication:

LINE DRAWINGS

Quick to interpret with clear annotation. Shows the components of the tool.



BEAUTY SHOT

Highlights the tool as a singular entity, showing its aesthetics and the materials used.



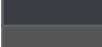

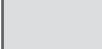


CONTEXTUAL PHOTO

Show the tool applied to a task, suggesting the lifestyle of users. Showcases well-used tools.



COLOUR SCHEME

Seven main colours are used to represent the brand:

	#000000	Category text
	#393C43	Banner, most text
	#5F6062	Dividing lines, subordinate text
	#DCDDDF	Outer backgrounds
	#82B4BD	Key text, bold underlines
	#FFD100	Logo and accents
	#FFFFFF	Backgrounds, contrast text

BRAND APPLICATION

For the presentation boards we applied the colour scheme, font choice, communication style as used by Leatherman.

Graphic styles were chosen based on the focus of each: tool components, tool as a whole or tool in use. These were made as described in Appendix B.

Composition of elements took inspiration from a range of pages from the Leatherman website.

PRODUCT CHOICE

The 'Surge', one of Leatherman's flagship models, was chosen for redesign: it is aimed partly at our target market (craftspeople), it has the most appropriate toolset, and it can be taken apart for maintenance.

FORUMS & REVIEWS

Reviews of leatherman multi tools, specifically the 'Surge', highlighted a range of issues, but also key attributes fundamental to the success of the product.

“

INAPPROPRIATE TOOL CHOICE

"A major reason to own a tool like this is for the convenience... want a slender profile and a smart design that gives you the most features at the minimum size." (The Multi tool, 2014)

“

THE TOOLS DON'T STAY SHARP

"I use the knife quite a bit but the blades do not stay sharp" (Leatherman, 2017)

“

TOOLS ARE DIFFICULT TO OPEN

"Why are the tools stored inside the handle are so hard to get out? The nail nicks are tiny, the springs (or friction) make the opening of, for example scissors, an adventure." (Koehler, 2015)

Part of this quote was used on the Problems presentation board.

INCLUSIVE DESIGN CONSIDERATIONS

Manual dexterity commonly deteriorates with age (Persad, Langdon and Clarkson, 2007), and osteoarthritis is "the leading cause of disability in later life" (March and Bachmeier, 1997). This emphasizes the importance of making the tool easy to open.

PERSONA

CREATION

The persona Ron (Appendix C) was created using the CURE elderly personas database as a guide (Wöckl *et al.*, 2012). This was supplemented with assumption-based characteristics (Marshall *et al.*, 2015) inspired by craft books, YouTubers with a similar attitude and our own personal experiences as semi-professional crafts-people.

APPLICATION IN PRODUCT DEVELOPMENT

Used as in Pruitt and Adlin (2010), to provide the mindset of an explicitly defined potential target user. This mitigates confusion for intra-team communication.

APPLICATION IN BOARDS

The boards have short statements inspired by Ron's task goals and a quote addressing the experience goals.

TASK ANALYSIS

Books, videos and our experience as semi-professional craftspeople all informed our understanding of the tools required, and the forms that are useful. (Stohlman, 1979; Underhill, 2011; Sellers, 2015; Cosman, 2016). According with on the 80/20 principle (Lidwell, Holden and Butler, 2010) the few most-used tools should be the most accessible.

HIERARCHICAL TASK ANALYSIS

HTAs are used to better understand the operations and ordering of tasks. (Stanton, 2006; Shepherd, 2000). The method was applied to a common woodworking task (Appendix D), providing a vertical slice of the tools required by craftspeople to see how Ron's Task Goals could be better achieved.

INNOVATION

TRIZ METHODOLOGY

TRIZ is a collection of methods for finding solutions to abstract problems and then applying these to specific cases.

INHERENT CONTRADICTION

One method is to first find apparently incompatible goals (along one axis), here (from user research):

Require more force to open tools;
require less force to open tools.

SEPARATION PRINCIPLES

These are then resolved using Separation Principles, here:

Separate the force required by time:

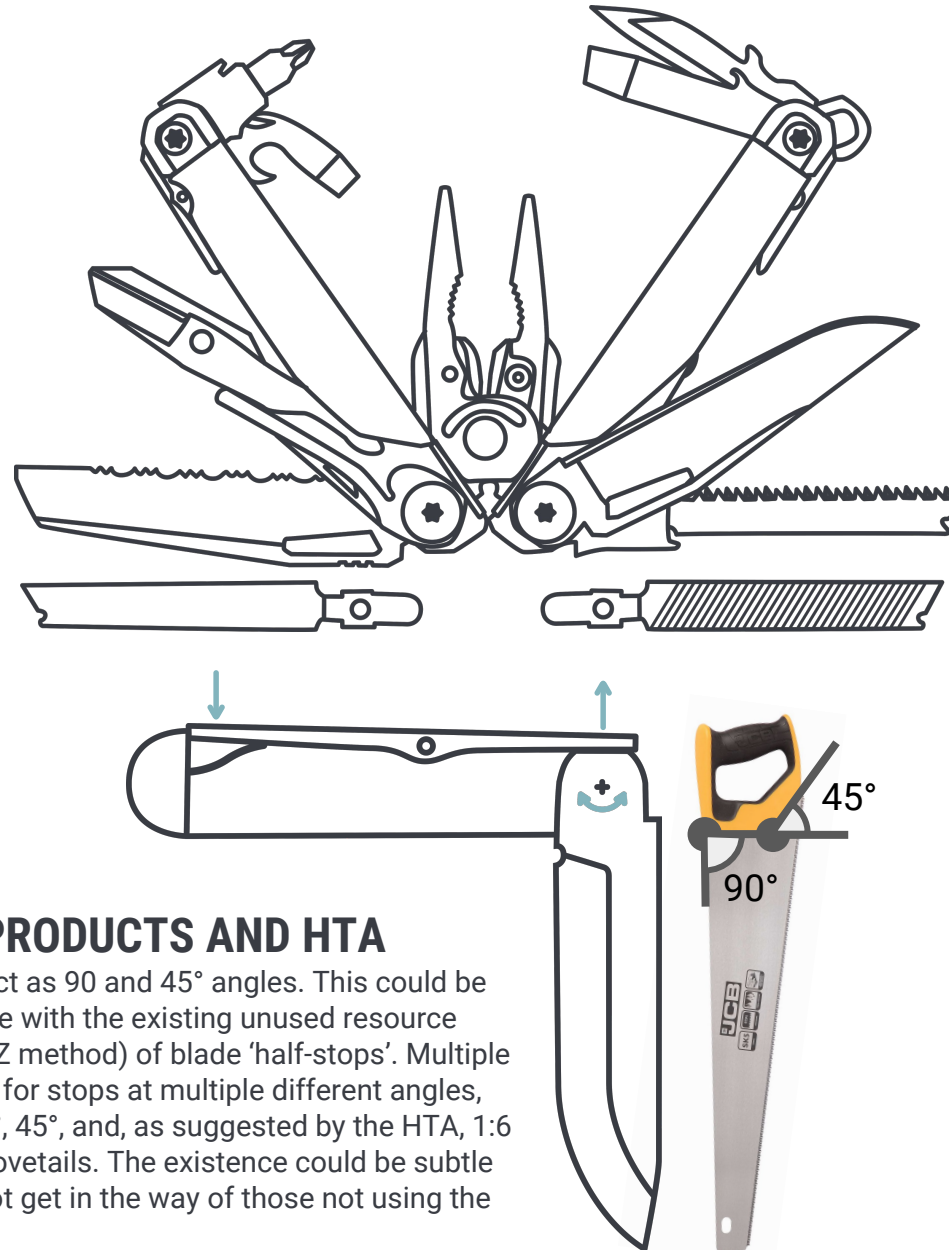
Keep the default blade spring highly tensioned, but allow a partial de-tensioning when opening a tool.

The diagram to the right shows a potential de-tensioning mechanism.

(Rantanen and Domb, 2010)

OTHER PRODUCTS AND HTA

Handsaws act as 90 and 45° angles. This could be achieved here with the existing unused resource (another TRIZ method) of blade 'half-stops'. Multiple blades allow for stops at multiple different angles, including 90°, 45°, and, as suggested by the HTA, 1:6 for cutting dovetails. The existence could be subtle enough to not get in the way of those not using the feature.



PERSONA

Each of the design decisions was considered against Ron's likely tasks and experience goals. (Appendix C).

TOOL CHANGES

Tool changes were based on issues found during user research.

FLATHEAD TO PARING CHISEL

A chisel allows material removal in the tighter spaces encountered in wood and leather work. The tool must not lock, so was given a slight angle to ensure pressure keeps it open.

Removing the small screwdriver makes the chisel and awl thicker and more stable in use.

CAN OPENER TO FLATHEAD

The can opener was an underutilised space on the tool, so was adjusted to give a dedicated flathead tip.

AWL TO MARKING KNIFE/AWL

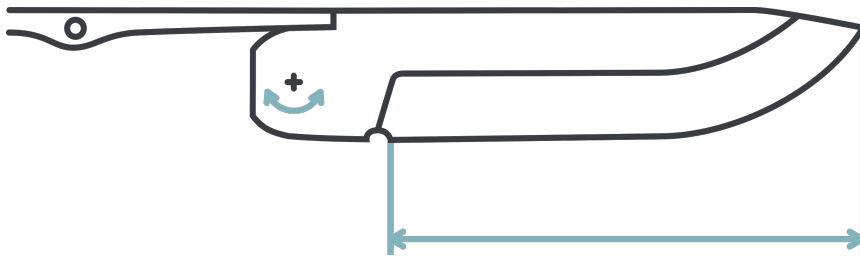
Adjusting to a bevel sharpened awl allows use as a marking knife for woodworking and carving.

(Appendix E for full tool list)

LEGAL

It is illegal to carry a knife in public without good reason, unless it comprises a folding blade with a length less than 3 inches (7.62cm). Blades must be held open by friction, or a backspring that can be disengaged by pressing on the blade (gov.uk, 2017).

By reducing the blade length (by 0.1") to meet these standards, our product is designed to ensure saleability in the UK market. By making the tool legal to carry with you, it is more likely to be used in day-to-day situations.



STEEL CHOICE

Changing blade materials from 420HC stainless steel to RWL34 martensitic powder steel will increase the hardness and toughness of the blades, as RWL34 is a development of 420HC with over double the carbon. The addition of chromium, molybdenum, and vanadium also gives greater rust resistance and durability (Brisa, 2017).

DESIGN FOR MAINTENANCE

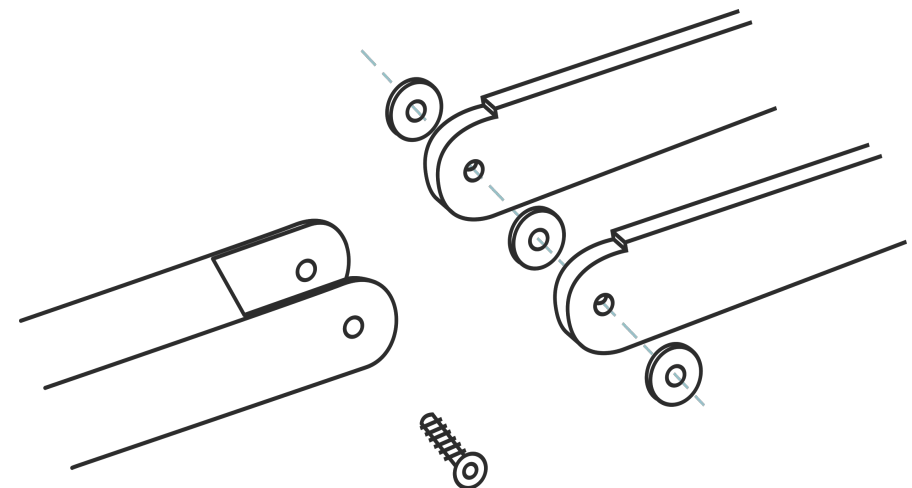
The change to PTFE as a material choice for the washers over stainless steel, as currently used, or brass or bronze as also common was twofold. PTFE gives the lowest co-efficient of friction against stainless steel (the blades) of 0.05-0.2, compared to 0.5-0.8 for steel-on-steel, and 0.16-0.4 for brass or bronze (Hall, 2009).

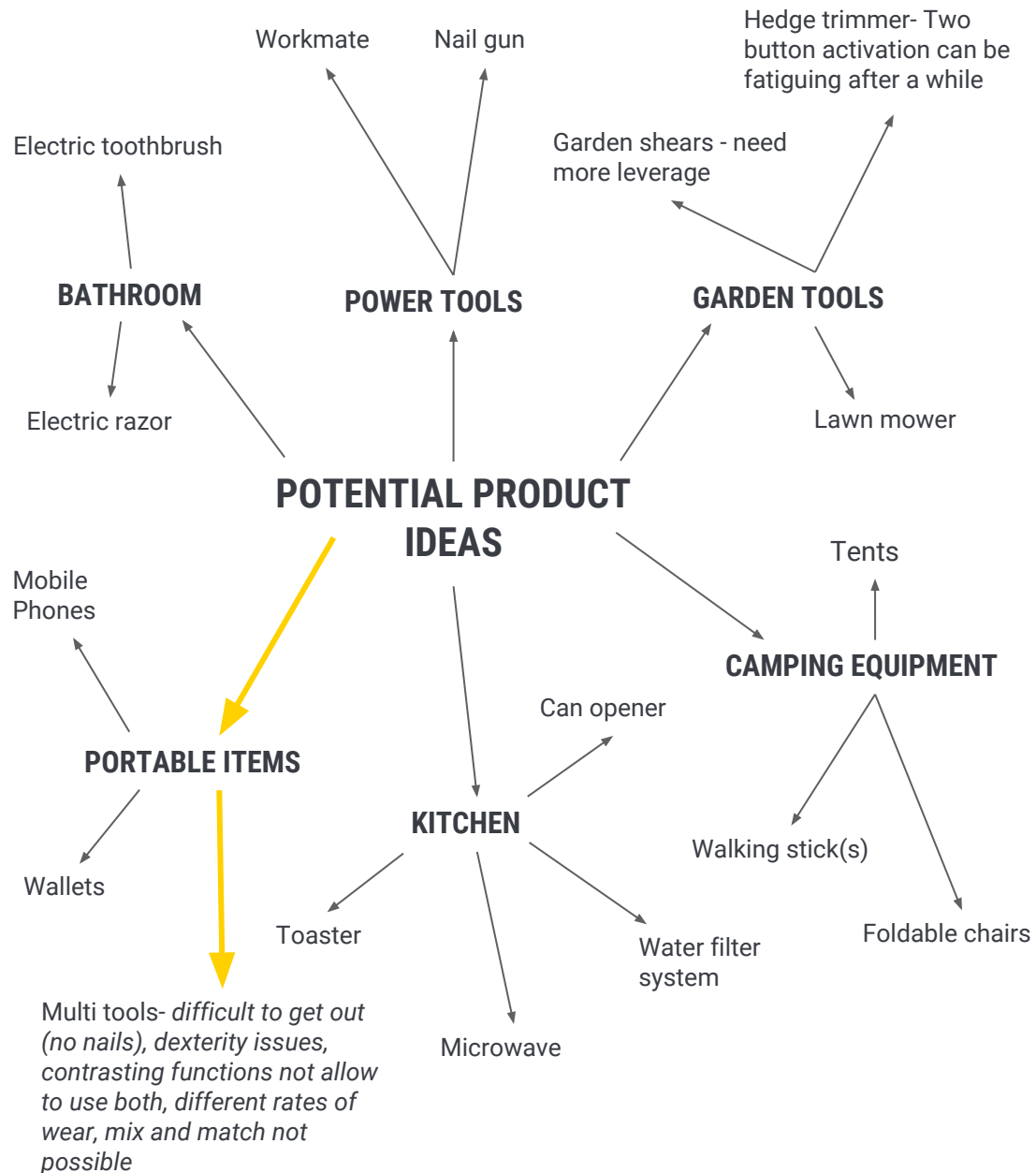
PTFE therefore reduces wear, and opening force, it also reduces rust potential from steel-to-steel, and galvanic corrosion potential from brass or bronze (NACE, 2015).

PTFE is also available in very thin sections, allowing the use of washers in all major bearing positions of the tool without compromising tool selection.

For a more complete analysis of failure modes, see Appendix F.

(Mulder et al., 2012)

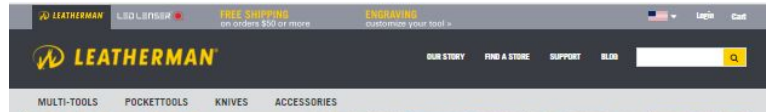




MEETING LOG

DATE	PRESENCE	LENGTH	DISCUSSION POINTS
13-Feb	All	1:30	Explored more product ideas. Looked more into and decided on the Leatherman. Come up with a few problems and immediate solutions
16-Feb	All	00:50	Started planning the logbook pages
24-Feb	All	02:30	Product research and discussed ideas
27-Feb	All	01:30	Persona and HTA creation
01-Mar	All	01:00	Sketching and CAD discussion
04-Mar	All	04:00	Logbook formulation and discussion of page layout and contents
05-Mar	All	02:30	Preparation and layout out of board ideas
08-Mar	All	02:00	Met with 5and6 and got some feedback on the initial board designs. Planned revisions based on feedback.
12-Mar	All	04:00	Finalising the solution presentation board
14-Mar	All	02:30	Printing

SCREENSHOTS OF WEBSITE



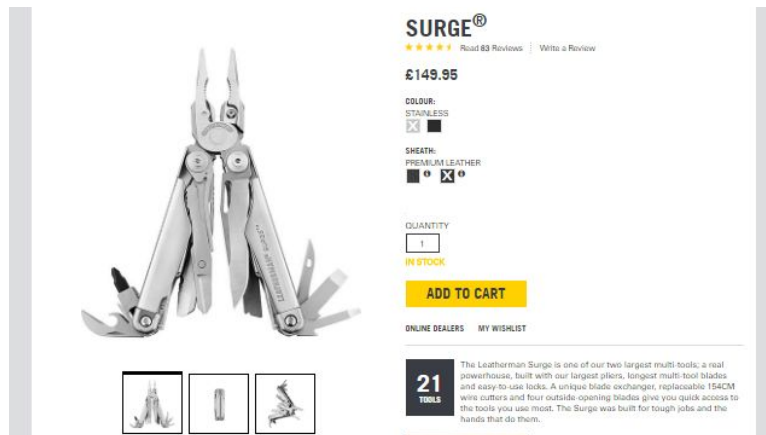
NAVIGATION BAR

The highly contrasting logo creates an attraction and maintains consistency across the site, an aspect which is used on the problem and solution boards.



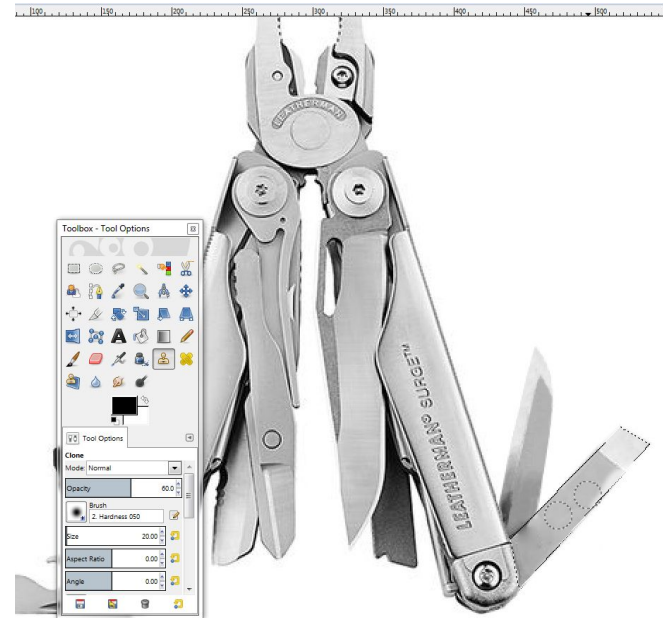
IMAGE GROUPS

Grouping of images help to break the page into harmonious areas of text and visuals. Meanwhile the image borders are angled to break up the tedium of the page and provide a more comfortable visual weighting of the group of images.



NEGATIVE SPACE

The use of negative space on the page provides a more comfortable visual weight. The page uses asymmetry to divide between text and visual information. (Lidwell, Holden and Butler, 2010)

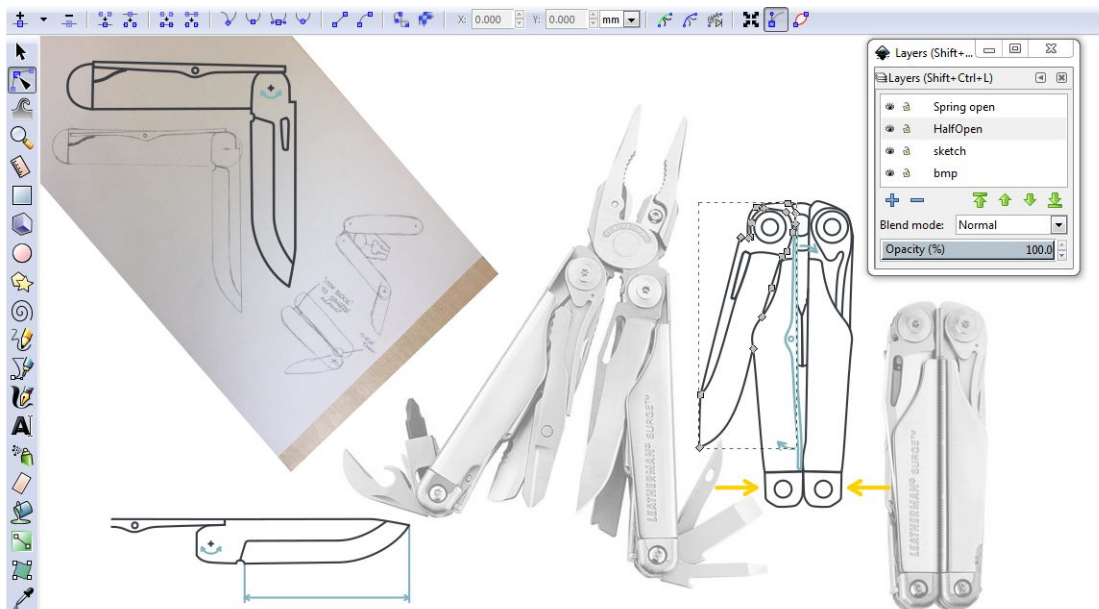


PHOTOS

Photos of the original Surge model were modified in the *GNU Image Manipulation Program* (GIMP) to provide a visual representation of the new model.

VECTORS

Vector drawings were made on *Inkscape* using sketches and Leatherman's photos as reference.





RON JONES

RON'S STORY

Ron is fiercely independent, having worked his entire life and earned enough to buy his house, and two properties he now rents out.

He renovated all the properties himself and finds it frustrating that doing the maintenance is getting harder for him as his tools seem to be getting heavier. Ron is very careful with money as he knows he doesn't want to work for much longer, but takes some time to enjoy and relax.

Ron's hobbies include craftwork, such as wood and leatherwork, for which he has a purpose built workshop. He also enjoys being out in the fresh air, and competes in rifle shooting events.

ON THE WEEKEND...

On the weekend he likes to spend time with his wife and their dog, walking in their local woods. After this Ron will tend to sit down for a few hours and rest.

Ron tries to spend as much time with his wife as he can but finds himself taking on little projects to amuse himself. He also often finds himself helping out with odd-jobs at his son's house or other properties.

PERSONAL INFORMATION

AGE: 62

SEX: Male

HOME: Lived in Taunton for 15 years, and his work headquarters is a few miles away.

RELATIONSHIP STATUS: Married to his wife for 34 years, she is in good health and is 64 this year.

EDUCATION: Left school at 16 with a couple of GCEs.

EMPLOYMENT: Worked in construction since leaving school, now as a site manager.

EXPERIENCE GOALS

Ron wishes to continue doing the things he enjoys, such as walking the dog and working on wood and leatherwork projects.

He is very scathing of new technology, and wants to be assured that products meet his expectations in their use.

He wants to remain passionate about his hobbies and maintain his skills when his life is less structured, after leaving work.

CONCERNS

Ron is concerned he is going to lose dexterity, especially when he stops work and reduces his activity. He has some arthritis in his hands due to use of power tools for many years, which becomes more problematic in the cold.

He is also concerned about retaining his independence as he grows older, he has one son, who lives close by, but he does not want to be a burden to him.

Ron is very long-sighted, requiring almost constant use of glasses, however he tends to lose or break them quite often.

TASK GOALS

Ron needs a tool that allows him the freedom of use to be valuable in all of his hobbies, as well as around the house.

He must be able to use the tool even if he is losing some dexterity and hand strength, similarly it must not present a risk to his safety.

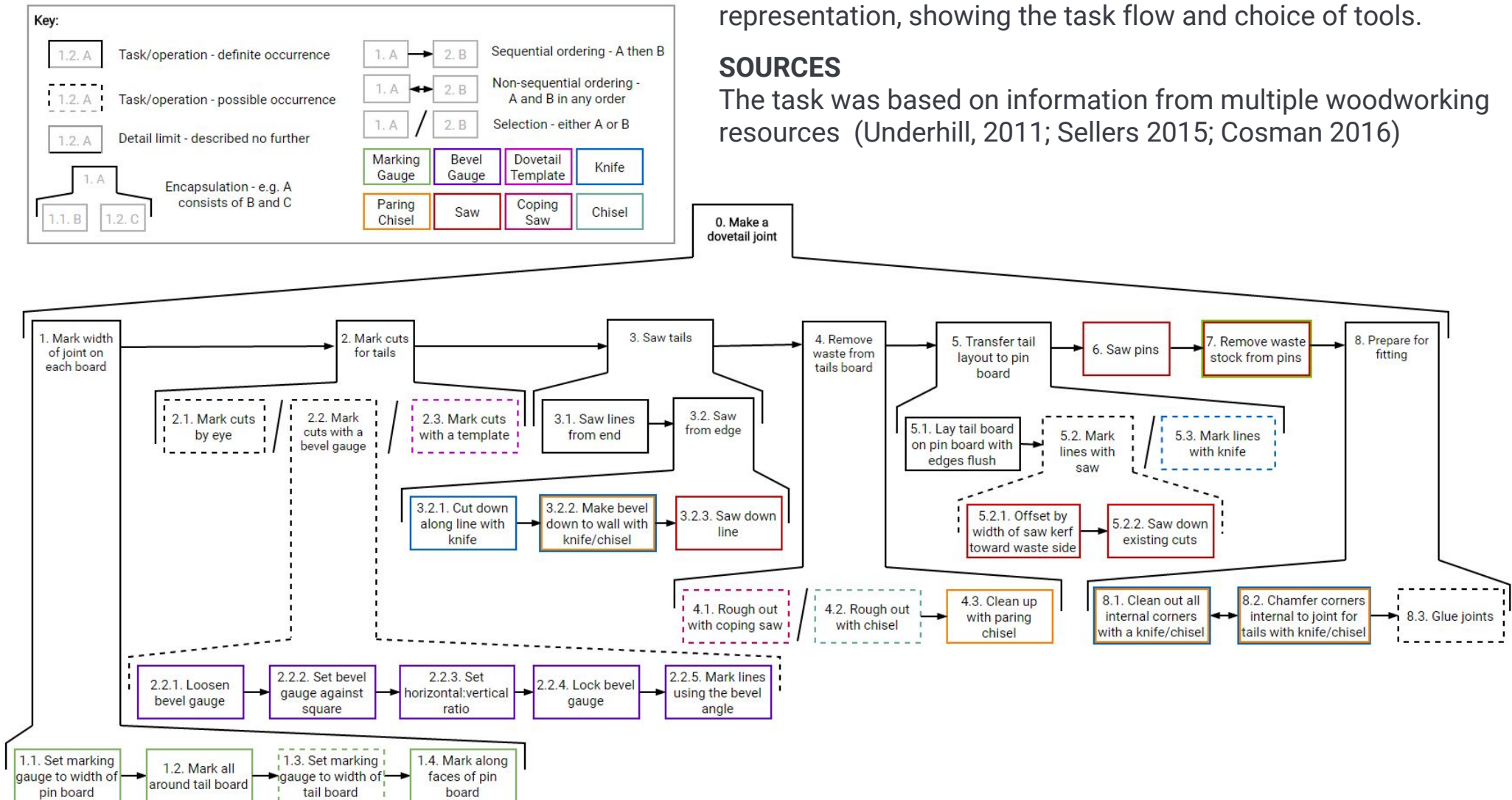
He needs confidence that the tool won't fail on him when he needs it, if it is to replace other tools he must be assured of its practicality and usability.

REPRESENTATION

The quintessential woodworking task of making a dovetail joint is analysed here using Reece's (unpublished) HTA representation, showing the task flow and choice of tools.

SOURCES

The task was based on information from multiple woodworking resources (Underhill, 2011; Sellers 2015; Cosman 2016)



PLIERS

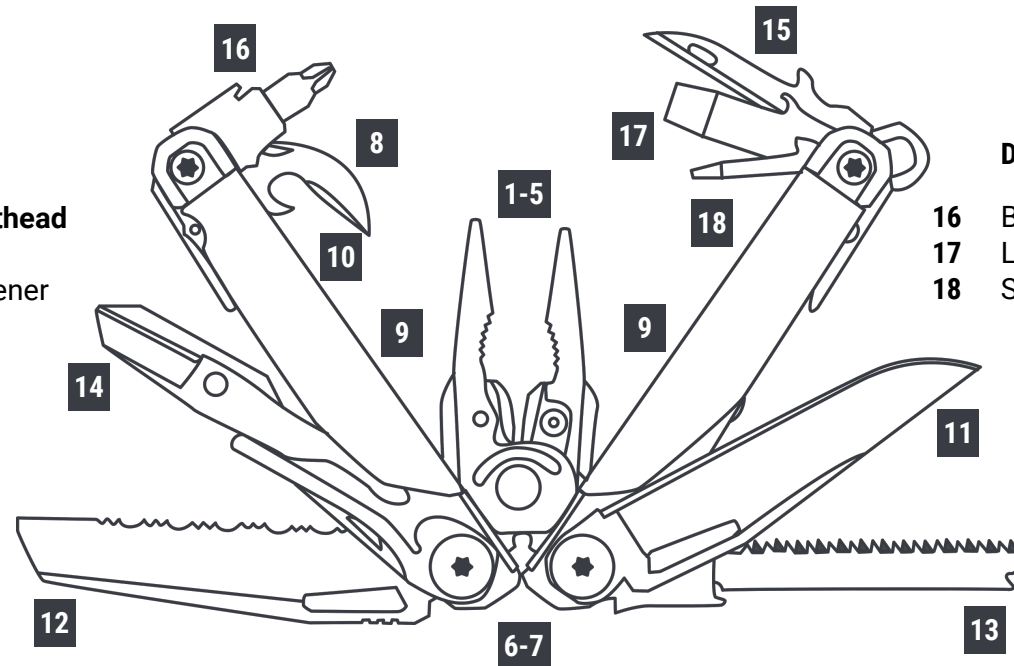
- | | | |
|---|-------------------------------|---------------------------------|
| 1 | Needlenose Pliers | → Needlenose Pliers |
| 2 | Regular Pliers | → Regular Pliers |
| 3 | Replaceable Wire Cutters | → Replaceable Wire Cutters |
| 4 | Replaceable Hard-wire Cutters | → Replaceable Hard-wire Cutters |
| 5 | Stranded-wire Cutters | → Stranded-wire Cutters |
| 6 | Electrical Crimper | → Electrical Crimper |
| 7 | Wire Stripper | → Wire Stripper |

MISC

- | | | |
|----|---------------|-------------------------|
| 8 | Can Opener | → Large Flathead |
| 9 | Ruler | → Ruler |
| 10 | Bottle Opener | → Bottle Opener |

DRIVERS

- | | | |
|----|-------------------|---------------------------|
| 16 | Bit Driver | → Bit Driver |
| 17 | Large Screwdriver | → ¼" Paring chisel |
| 18 | Small Screwdriver | → (removed) |



BLADES

- | | | |
|----|-----------------------------|--------------------------------------|
| 11 | 420HC Knife | → RWL34 Knife |
| 12 | 420HC Serrated Knife | → RWL34 Serrated Knife |
| 13 | Blade Exchanger® | → Blade Exchanger® |
| 14 | Spring-action Scissors | → Spring-action Scissors |
| 15 | Awl w/ Thread Loop | → Marking/carving knife / awl |

HUMAN ERROR

A lack of maintenance leading to rusting/seizing (lapse in attention/knowledge based mistake assuming SS is completely maintenance free).

Breakage due to misuse (knowledge-based errors assuming it's okay to use a tool for what you're trying to do, or violation, knowing you shouldn't use the tool for that but doing it 'because you have to'). These situations are prevented by minimising user maintenance, improving steel quality, and providing clear warnings against misuse. (Reason, 1990)

INJURY

Injury resulting from the product use likely to be from sharp edges, these are crucial to use and inherently cannot be guarded.

Injury through product failure would be through sharp edges produced by breakage of through-hardened tools. Prevention is highlighted in the 'Breakage' section. Adequate tool provision for likely situation prevents misuse, however there must be warning advising against prying or torquing the blades/file.

RUST

Rust points on knife are most likely between blades and washers where moisture can be trapped in pivot points, or contact between springs and backplate.

Rust will cause increased friction between components, leading to eventual seizing. Use of PTFE washers means blades should not be able to seize as there's no metal/metal contact.

Other rust points are the case, this largely relies on materials (stainless steel) and user care.

Tool can be disassembled due to use of torx heads, so cleaning and rustproofing is possible. Use of RWL34 steel and self lubricating PTFE washers minimises tool rusting.

SUMMARY

Failure modes of the product not addressed within the design are largely human error based. These arise from intentional misuse, accidental misuse, and inattention.

Errors such as accidental contact with the blade are difficult to guard against as any guarding reduces the effectiveness of the tool itself. Misuse of the tools should be prevented by ensuring appropriate tooling is usable.

Further controls are of manufacturing and supply chains. Process control that is validated and subject to quality control ensures product tolerances are met. Similar standards expected of the supply chain should ensure consistent material standards and tolerances.

BREAKAGE

The likely failure mode leading to tool breakage is for it to snap. This is most likely with through-hardened tools such as the knife, saw, and file.

Snapping could be due to misuse (torque on the tool, using as a pry-bar) or a manufacturing flaw such as a bubble, or grain growth from incorrect heat-treatment.

Ensured quality control, with multiple validations of crucial elements such as temperatures during manufacture and during quality control prevents this. Purchasing steel from reputable dealers should prevent supply flaws. (Verhoeven, 2005)

Brisa 2017. Blade steels - brisa.fi. [online] Available at: <http://brisa.fi/steel.html> [Accessed 6 Mar 2017]

Cosman, R. 2016. *Rob Cosman teaches Skills NB student Gregg "dovetails"*. [video] Available at: <https://www.youtube.com/watch?v=TedpbRo0y4w> [Accessed 27 Feb. 2017].

Gov.uk. 2017. *Selling, buying and carrying knives - GOV.UK*. [online] Available at: <https://www.gov.uk/buying-carrying-knives> [Accessed 6 Mar. 2017].

Hall, H. 2008. *The metalworker's data book*. 1st ed. Poole: Special Interest Model.

Koehler, Kenny. *Leatherman Signal Multi-Tool Review | Pro Tool Reviews*. Pro Tool Reviews. N.p., 2015. Web. 14 Mar. 2017.

Leatherman. (2017). *Surge (Reviews)*. Retrieved from Leatherman.com: <https://www.leatherman.com/surge-3.html>

Lidwell, W., Holden, K. and Butler, J., 2010. *Universal principles of design, revised and updated: 125 ways to enhance usability, influence perception, increase appeal, make better design decisions, and teach through design*. Rockport Pub.

March, L. M., & Bachmeier, C. J. 1997. 10 Economics of osteoarthritis: a global perspective. *Baillière's clinical rheumatology*, 11(4), (817-834).

Marshall, R., Cook, S., Mitchell, V., Summerskill, S., Haines, V., Maguire, M., Sims, R., Gyi, D. and Case, K., 2015. Design and evaluation: End users, user datasets and personas. *Applied ergonomics*, 46, pp.311-317.

Mulder, W., Blok, J., Hoekstra, S. and Kokkeler, F., 2012. *Design for maintenance: guidelines to enhance maintainability, reliability and supportability of industrial products*. Enschede, University of Twente.

NACE International. 2015. *Galvanic Corrosion*.

Norman, D. A. 2005. *Emotional Design: Why We Love (or Hate) Everyday Things*. Basic Books, 2005.

Persad, U., Langdon, P. and Clarkson, J., 2007. Characterising user capabilities to support inclusive design evaluation. *Universal Access in the Information Society*, 6(2), pp.119-135.

Pruitt, J. and Adlin, T., 2010. *The persona lifecycle: keeping people in mind throughout product design*. Morgan Kaufmann.

Rantanen, K. and Domb, E., 2010. *Simplified TRIZ: New problem solving applications for engineers and manufacturing professionals*. CRC press.

Reason, J., 1990. *Human error*. Cambridge university press.

Sellers, P. 2015. How to make a Dovetail Joint - The Three Joints - with Paul Sellers. [video] Available at: <https://www.youtube.com/watch?v=OCYjoj6cfno>. Accessed 27 Feb. 2017].

Shepherd, A., 2000. *Hierarchical task analysis*. CRC Press.

Stanton, N.A., 2006. Hierarchical task analysis: Developments, applications, and extensions. *Applied ergonomics*, 37(1), pp.55-79.

Stohlman, A., 1979. *The Art of Making Leather Cases*. Tandy Leather Co. Fort Worth, Texas.

Underhill, R., 2011. *The Woodwright's Guide: Working Wood with Wedge and Edge*. Univ of North Carolina Press.

Verhoeven, J.D., 2005. Metallurgy of steel for bladesmiths & others who heat treat and forge steel. *Iowa State University*, pp.66-68.

The Wirecutter 2014. *The Best Multitool*. Retrieved from The Wirecutter: <http://thewirecutter.com/reviews/best-multitool/>

Wöckl, B., Yildizoglu, U., Buber, I., Aparicio Diaz, B., Kruijff, E. and Tscheligi, M., 2012, October. Basic senior personas: a representative design tool covering the spectrum of European older adults. In *Proceedings of the 14th international ACM SIGACCESS conference on Computers and accessibility* (pp. 25-32). ACM.

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