

Detailed Research and Requirements Development

Info in red font is for the benefit of the teacher (ideas for differentiated learning etc). Delete text in red font from the copies that are distributed to students. In a document / template that is intended to be "filled in" by students for assessment / evaluation purposes, the Version History table can be retained for students to use. Making an improved version 2 or 3 is great learning and should be encouraged. Show the class how easy it is to automatically generate and modify a Table of Contents using the features of the word processing technology. Because this unit is early in the course, significant review of fundamentals is included in the documents supporting this unit.

CC = Significant cross-curricular learning opportunity

Version History:

V #	Date	Author	Short Listing / Description of Changes
1	May 7/12	D.B. McCowan	Initial Version -- uploaded to OCTE Safety Portal
2			

Table of Contents

1	Expectations.....	1
2	This Lesson is Important Because... ..	2
3	Review – Core Thinking Skills for the Task of Finding Information.....	2
4	Requirements Development -- Based on Very Important Research.....	2
4.1	Version 1 -- Preliminary Draft Using Recall and Interpret Thinking Skills.....	2
4.2	Version 2 – Improved Draft Based on Strategic Detailed Research.....	3
4.2.1	Practice -- Research for More Detailed Requirements	4
5	Assignment – Two Design Documents.....	6
5.1	Criteria Common to All of Your Design Documents	6
5.2	Research Report (Say 500 Words Approx)	6
5.3	Requirements Document (A One Page Table).....	7
6	Safety Reminder.....	7
7	Self and Peer Assessment	7

1 Expectations -- Finding and Processing Information

Design / Build a Marketable Picture Frame Using Scrap Wood Flooring	
1 Curriculum Expectation <i>In this unit the student will demonstrate / practise the following:</i>	2 Activity -- What You Will Do in this Lesson
B4.2 -- report and reflect on their experience with the design process using a suitable oral and / or written format	-find information and process information using the full range of core thinking skills -write a research report -write the Requirements document

Table 1: Expectations

2 This Lesson is Important Because...

If you want to design, build and market a product, you'd better first decide what you want it to look like and how you want it to perform – at the very least. This will involve some research and the use of your core thinking skills to find relevant and value-added information.

3 Review – Core Thinking Skills for the Task of Finding Information

To do valuable research for a project – you want to build something and build it right, right? – takes serious thinking. Finding information is an early task in your research phase and, in turn, research is a part of project planning. Finding information is a thinking task that you should practice as often as possible. Match the following core thinking skills to the given sub-task or mini-task listed in column 2. You must use each of the seven core thinking skills exactly once. Insert your answer in column 3. There is a best match for each statement.

Note to Teacher: Delete the answers in red font before distribution of this review exercise.

Core Thinking Skills

Recall Translate Interpret Apply Analyze Synthesize Evaluate

1 #	2 Sub/Mini-Task in Relation to the Larger Task of Finding Information	3 Core Thinking Skill
1	You use a synonym for 'frame' in a web search	Translate
2	You judge a web site as to its credibility and reliability based on criteria set by your company	Evaluate
3	You draw preliminary conclusions after you sort your findings	Analyze
4	You remember that oak and ash are hardwoods.	Recall
5	You use your knowledge of and skills for finding information on the internet to find information in the city library.	Apply
6	You sort your research findings into significant categories in a table.	Interpret
7	You design and build a database using relational database software in which to store and categorize your research findings. (This database would be an optional task for students who want to do more in this course – and talk to your business applications teacher about this too.) (CC – DL-H.)	Synthesize

Table 2: Review Core Thinking Skills

4 Requirements Development -- Based on Very Important Research

4.1 Version 1 -- Preliminary Draft Using Recall and Interpret Thinking Skills

If you did a decent job in the 13 Fundamental Concepts practice exercise in the previous file (1.7_13_Concepts_in_Context.doc) -- that is, you used your own words -- then, guess what? You've already drafted a very preliminary version 1.0 Requirements document for your picture frame project. If, in that practice exercise, you were working only with 'what I already know' (your Recall thinking skill) then chances are you'll need to do a good bit more research before writing an improved version 2.0 of your Requirements document.

4.2 Version 2 – Improved Draft Based on Strategic Detailed Research

In addition to applying the 13 fundamental concepts of technology to a design problem – the picture frame – you should dig or research much deeper. For instance, to make the most creative picture frame in the class, you may want to research various techniques for fabricating them. Fabrication is such an important topic that we will return to it again in the next lesson.

In any event, this Requirements-writing stage is when you begin to synthesize or build your detailed plan for achieving your goal. Keeping in mind your goal to make a picture frame out of scrap flooring using hand tools, now you have to start making a list of:

- Construction requirements -- basically what the picture frame must look like
- Performance requirements -- basically what the picture frame must behave like or do

Your Requirements are your set of targets – precise statements of what you are aiming for within a very particular and narrow scope (eg how big it will be).

But wait, you want to make the best, most creative picture frame in the class! You can imagine your picture frame fetching \$100.00 at a community-wide fundraising auction sale that you'll encourage the class to organize. So, your requirements list must go well beyond interpretation of the 13 fundamental concepts and beyond basic construction and performance. You must set your requirements, that is your standards, high – high enough to set your picture frame way above everyone else's.

Hold on again! So far, we've talked about requirements for your PRODUCT – your picture frame. And yes, these are YOUR requirements – because it is your product. Sure, the teacher will probably give you some minimum requirements, but you want your picture frame to be way better than that! Now, what about your requirements for your LEARNING?

In file 1.6_DesignBrief.doc, you asked the following question when you looked at the original situation:

1. What else might we need in order to translate this situation into an achievable opportunity?
 - a. What do we need to know?
 - b. What do we need to be able to do?
 - c. What do we need to communicate to others?
 - d. What little problems might we encounter along the way?

As you proceed with your research into making a wooden picture frame, you should be thinking about what it is that you want to achieve for your learning – your **Requirements** for your own learning. After all, you will be graded on the following four Achievement categories:

- a) Knowledge -- need to know
- b) Application -- be able to do
- c) Communication -- report to (or tell) others
- d) Thinking -- what little problems might we encounter along the way

4.2.1 Practice -- Research for More Detailed Requirements

So, with an open mind, get started on your detailed research. Of course, you will need to find relevant information and come to some understanding of it. For example, become very familiar with typical terminology regarding picture frames and working with wood. Also...

- Identify up front, as best you can, what you are looking for – important concepts to understand and skills to develop
- Investigate
 - locate useful information from within a jumbled disorganized array of sources
 - judge the integrity and reliability of your sources
 - look at samples that have gone before -- analyze the mistakes and successes of others -- reverse-engineer previous similar products
 - Gather "best practices", "rules of thumb" and other limitations for design and fabrication based on the experiences of others
 - Ask more questions
- Process your information set – interpret, analyze, clarify, understand, sort, categorize, and finalize in a good document.

In the following practice exercise, match the given sample additional requirement in column 2 to the most relevant of the 13 fundamental concepts of technology (insert your answer in column 3). Do enough research on your own to generate at least two more of your own requirements and insert them into the table.

In column 1, label each requirement as either C = Critical (Must Have) or NC = Not Critical (Nice to Have).

Note to teacher:

Differentiated Learning Ideas	
Abbrev	Description / Notes – Refer to the Table Below
DL-L	For students with lower abilities -Give them a research information sheet which addresses all of the issues in the table below -They should generate at least one more requirement of their own -They are to very briefly justify at least two of their matching answers -They may rank no more than two thirds of the requirements as `Not Critical`
DL-M	For students with moderate / mid-range abilities. This should generally be the default, always involving some level of critical thinking. -Give them 5 decent websites which, together, address most of the issues in the table below -They should generate at least two more requirements of their own -They are to very briefly justify at least three of their matching answers -They each pick one of the requirements, dig deeper and write a 100 word detailed explanation – a mini version 1.0 research paper on this particular topic -They may rank no more than one third of the requirements as `Not Critical`
DL-H	For students with higher abilities or, ideally, "for any students who want to do more". -Tell them to do their own research and to cite their sources -They should generate at least three more requirements of their own -They are to very briefly justify at least four of their matching answers -They each pick three of the requirements, dig deeper and write a 100 word detailed explanation

Differentiated Learning Ideas	
Abbrev	Description / Notes – Refer to the Table Below
	regarding each. Link the 3 explanations into a well-organized version 1.0 research paper. Justify why they would use these 3 requirements in their project. -They may rank no more than one quarter of the requirements as 'Not Critical'

In the table below, it is suggested that sample requirements labelled 'C' (Critical) in column 1 be non-negotiable – students should not be permitted to choose these as NC (Not Critical). Students should add at least two more of their own Requirements (depending on ability as above). Then take up in class.

Delete the sample answers and other text in red font before distribution of this exercise.

1 C or NC	2 Sample Additional Requirement from Your Detailed Research	3 Matching Fundamental Concept
	The four rails of the picture frame must be given a clear transparent finish to preserve the patina of the century-old oak flooring and the natural flaws and features of the ash.	Aesthetics
	Nails / screws must not be visible on the outside of the frame	Aesthetics
C	The tongue and groove features in the flooring pieces must not be entirely removed.	Innovation – purposeful uniqueness at the very least
	The flooring pieces must still look like flooring pieces when viewed from the room in which the frame is installed.	Aesthetics
C	If glue is used at the four rail joints, quality wood glue must be used.	Material – importance of specifications, MSDS and reading instructions
C	There must be a `ledge` or lip on the back of the frame in which the glazing, matting, picture or artwork and backing are securely mounted.	System
	Matting and backing must be acid-free.	Sustainability – to prevent contamination / degradation of the artwork
	The frame must be rectangular with an aspect ratio of 9:5.	Structure -- geometry
C	DL-H -- Angles between pairs of adjacent rails must be 90° plus or minus 0.5° DL-M -- Angles between pairs of adjacent rails must be 90° plus or minus 1.0° DL-L -- Angles between pairs of adjacent rails must be 90° plus or minus 2.0° This requirement should spark some debate about accuracy because different frames, although all rectangular, may have different perimeters. DL-H: Students who have learned about trigonometry should be encouraged to calculate the difference in length of the two diagonals of a square as the angles at the four corners are changed by + or – 0.5°. These students can then instruct other students in the class on using the resulting much simpler method of measuring "squareness" (difference in lengths of the two diagonals).	Control – making good measurements is an aspect of having control over fabrication Structure could be argued
	The glazing must be acrylic, must be rectangular and must fit the frame.	Safety – glass might shatter
	On the back of the frame, a fifty word (approx) notation must be printed outlining the story behind your frame and the flooring materials.	Innovation – explain your creativity in seizing this opportunity
C	The finished frame must not have any twist and must be in a single plane (if placed on a flat table, the frame must not wobble.)	Function – if excessively twisted the frame may not hold the other parts
C	When finished, a diagonal load of 5 pounds pushing vertically downward on one corner of the frame must not cause any distortion of the frame or displacement of parts	Energy – strength to resist an applied loading of a force

1 C or NC	2 Sample Additional Requirement from Your Detailed Research	3 Matching Fundamental Concept
	or weakening of joints.	(energy) Structure could be argued
	When finished, a pull of 5 pounds on opposite rails must not cause any distortion of the frame or displacement of parts or weakening of joints. The 5 pound pull will also be applied at opposite corners of the frame.	
	<i>Based on your research, add your own requirement here</i>	
	<i>Based on your research, add your own requirement here</i>	
	<i>Based on your research, add your own requirement here</i>	

Table 3: Sample Additional Requirements for Wooden Picture Frame

As you can imagine, you could conceivably combine parts of Table 3 immediately above and the "13 Fundamental Concepts of Technology in Context" exercise table in the previous file (1.7_13Concepts_in_Context.doc) and you would have a pretty decent sense of where you are heading with your picture frame project, and how to get there. You might even be tempted to call this combined set of information both your Research Report and your Requirements document. But this will give you a rather low mark for this stage of the design process depending on how much of the work was your own. You can do much better! Complete the two part assignment in the next section below.

5 Assignment – Two Design Documents

5.1 Criteria Common to All of Your Design Documents

All design documents must meet the usual requirements for good written communication -- "written by", "checked by", project title, document type ("Research Report" etc), date, revision history, aesthetically pleasing format and presentation, correct spelling and grammar. You may include labelled visual images, sketches or models. Sketches may be simplified models. Some documents (or parts of a document) should be structured as a table of related information in columns and rows. Most documents should be organized or sub-divided into logical headings and sub-headings. Detailed documents should have a Table of Contents, list of figures and list of tables. All documents must have a footer on every page. You may consolidate all design documentation into one document -- properly organized by headings and sub-headings. You must cite your sources and include a bibliography. Your design documentation will be graded against Written_Report_Rubric.doc.

5.2 Research Report (Say 500 Words Approx)

Now you will output – synthesize – a much more organized and useful package of information than the jumble of sources that you recently sifted through during your research. This `package` is your research report – a concise summary of what you have discovered that is reasonably relevant to your design project. Integrate your newly-found information with "*what you already knew*". Review the introduction to the previous section, 4.2.1 (Practice), to see what you should include. In your research report, you are not making any decisions – just stating useful facts in a very organized manner. Include the following in your research report as well:

- Bibliography of research resources
- Appendix of rough sketches with "pros" and "cons" for each alternate idea that came up in brainstorming during the research phase (make no decisions here though)

5.3 Requirements Document (A One Page Table)

After you complete your fact-finding Research Report, you are in a better position to make some decisions – to set your specific targets or Requirements for your product. You will be using your high-order thinking skills – analyze, synthesize and evaluate. A numbered list or a table format is advisable because some Requirements will be higher priority than others (eg Must-Have, Should-Have, Nice-to-Have). Note that your Requirements document can be used as a starting point for your test plan – when you will confirm that your product actually **does do** what you **wanted it to do**.

DL-L

- state what your product must “look like” – construction requirements
- state what your product must “behave like” – performance requirements

DL-M

- address the 13 fundamental concepts of technology at a minimum
- you must meet any minimum requirements given to you by the teacher

DL-H

- additional requirements for fabrication and good workmanship that you learned about earlier in the course
- additional requirements set by you in order to set your product apart from others -- to make yours the best! (eg practicality, durability, size, reliability, modularity, "buildability", "service-ability", adaptability, end-of-life and other key parameters)
- additional requirements set by you regarding your own learning

6 Safety Reminder

If your planning documentation is unclear or incorrect or incomplete, people can make mistakes and accidents can happen.

7 Self and Peer Assessment

NOTE: In the feedback, the Peer Assessor must “make the student think” – not give the student the answer! Be sure to include comments justifying the assessment value that you are giving. Peer Assessor must put his / her comments in red font.

Assessor's Name and Additional Notes:

--