



# TechSage Tool: Design Iterations Tracking (v1)

Rehabilitation Engineering Research Center on Technologies to Support Aging-in-Place for People with Long-Term Disabilities (RERC TechSage)

[rercTechSage.org](http://rercTechSage.org)

Correspondence concerning this report may be addressed to:

| **Wendy A. Rogers** ([wendyr@illinois.edu](mailto:wendyr@illinois.edu))

| **Tracy L. Mitzner** ([tracy@gatech.edu](mailto:tracy@gatech.edu))

## Suggested Citation

TechSage (2019). *TechSage Tool: Design Iterations (V1)*. Rehabilitation Engineering Research Center on Technologies to Support Aging-in-Place for People with Long-Term Disabilities.

## Acknowledgments

The contents of this tool were developed under a grant from the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR grant number 90REGE0006-01-00) under the auspices of the Rehabilitation and Engineering Research Center on Technologies to Support Aging-in-Place for People with Long-Term Disabilities (TechSage; [www.rercTechSage.org](http://www.rercTechSage.org)). NIDILRR is a Center within the Administration for Community Living (ACL), Department of Health and Human Services (HHS). The contents of this tool do not necessarily represent the policy of NIDILRR, ACL, or HHS, and you should not assume endorsement by the Federal Government. We thank Megan Bayles for her significant contribution to the development of this tool.

# TechSAge Tools Overview

TechSAge has designed this tool series to provide its readers with guides on how to conduct various aspects of human factors research. The tools have a focus on including the target population of older adults with disabilities. TechSAge Tools are designed to:

- 1) Introduce a variety of research methods, procedures, and protocols
- 2) Provide guides and “how tos” about implementation
- 3) Discuss considerations specific to working with adults aging with disabilities
- 4) If applicable, recommend appropriate wording to describe the method in publications
- 5) Point to reliable resources for more in-depth information about the method, procedure, or protocol presented in the tool

This TechSAge tool discusses strategies for successful iteration tracking for research and product development. Specifically, how designing for older adults with disabilities can slim down the iterations and increase usability.

By implementing a tracking system for iterations, researchers and developers are able to have ground for why decisions are made. When designing for older adults with disabilities, you are designing for universal use. By

## Table of Contents

<b>Introduction</b> .....	<b>4</b>
<b>For designers</b> .....	<b>4</b>
<b>For researchers</b> .....	<b>4</b>
<b>How Tos</b> .....	<b>5</b>
<b>Tracking design iterations</b> .....	<b>5</b>
<b>Implementation in Research</b> .....	<b>5</b>
<b>Guide for product design Iterations</b> .....	<b>5</b>
<b>Table 1. TechSage Tool Product Design Iteration Tracking Excel Template Details</b> .....	<b>6</b>
<b>Guide for research study iterations</b> .....	<b>6</b>
<b>Table 2. TechSage Tool Research Study Iteration Tracking Excel Template Details</b> .....	<b>7</b>
<b>Table 3. Research study or intervention study phase examples</b> .....	<b>8</b>
<b>Working with Older Adults With Disability</b> .....	<b>9</b>
<b>Table 4. Universal Design Principles</b> .....	<b>10</b>
<b>Table 5. 7 Principles of Ability-Based Design</b> .....	<b>11</b>
<b>Method Section Example</b> .....	<b>12</b>
<b>Product Design Iterations</b> .....	<b>12</b>
<b>Intervention Design Iterations</b> .....	<b>12</b>
<b>Summary</b> .....	<b>13</b>
<b>Resources</b> .....	<b>14</b>
<b>Useful Websites</b> .....	<b>14</b>
<b>References</b> .....	<b>15</b>

# Design Iterations and Tracking

## INTRODUCTION

Tracking design iterations is beneficial for 1) designers to track design changes to improve their product or service and 2) researchers to track study or intervention design changes to improve upon or adapt the research materials, stimuli, or protocol. The Design Iterations tool discusses why design iterations are important for product development and research protocols, and describes methods for tracking design iterations for each of these applications. The tool also presents principles related to inclusive design and discusses tracking design iterations specific to certain user groups, such as those with disabilities.

### For designers

Making design iterations for the purpose of helping designers improve on a product is one of the faster methods to implement product changes; this helps developers bring products to the market quickly and keep them competitive (Eppinger, Whitney, Smith, & Gebala, 1994). By tracking design iterations, designers can identify trends regarding what may be causing problems, and in turn, improve efficiency and detect higher level solutions (Eppinger et al., 1994). It is suggested to assess higher level components of a product first (i.e., menu structure), followed by an assessment of lower level features (i.e., a specific webpage). It can also be helpful to have different evaluators assess different aspects of the product and then come together to understand common and unique issues between assessors.

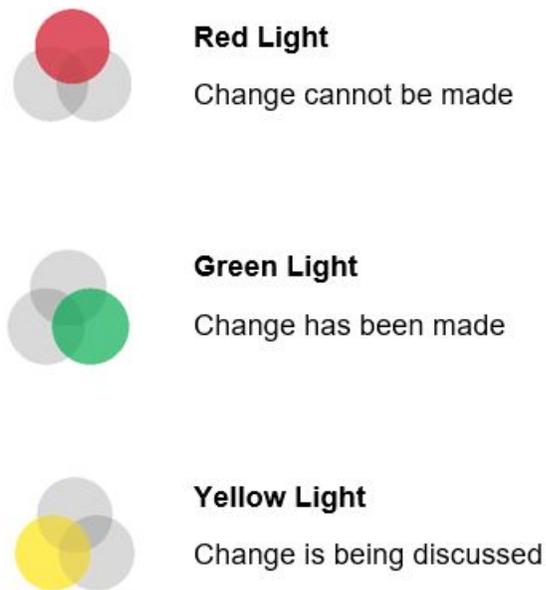
### For researchers

Design iterations for research studies or interventions are made to improve upon the materials or protocol of a study, to improve the feasibility, or adapt an intervention from one format, context, or population to another. For example, the screening criteria in a study might be modified to improve recruitment without sacrificing study goals. In doing a translational intervention, adaptations might be made to an original intervention while maintaining the integrity of the intervention. These types of iterations require more detailed tracking than in a product design process because a team may need to report the adaptations and their reasoning behind them to the original intervention developers or in a journal article. Implementing design iterations for an intervention can be beneficial as it allows researchers to make modifications to an intervention to meet the needs of a new target group or different context than originally intended.

## HOW TOS

### Tracking design iterations

It is important to use a systematic process for evaluating design iterations. One useful method is the Adaption Traffic Light framework (Firpo-Triplett & Fuller, 2012; Rolleri et. al, 2014). This framework provides a quick evaluation of which iterations need to be discussed, which have been completed, and which changes cannot be made.



*Figure 1: Firpo-Triplett & Fuller, 2012*

Below we will present guidelines about the types of iterations to track for product design iterations and intervention/study design iterations.

## IMPLEMENTATION IN RESEARCH

### Guide for product design Iterations

Below are design iteration guidelines for products. The guidelines correspond to the “TechSAGE Tool Product Design Iteration Tracking” excel template. The excel template and example files are available from authors on request. The template column labels and descriptions are presented in Table 1.

**TABLE 1. TECHSAGE TOOL PRODUCT DESIGN ITERATION TRACKING EXCEL TEMPLATE DETAILS**

Column Names	Descriptions
<b>Date</b>	Date that the suggested change was recommended
<b>Category</b>	<p>If there are aspects of the design process that are being evaluated categorically or in a sequential or prioritized manner—that information should be input into the ‘category’ column.</p> <p>Example: Mobile Application Product (in the excel template)</p> <ul style="list-style-type: none"> <li>- Homepage</li> <li>- Main Menu</li> <li>- Settings</li> </ul>
<b>Question/Comment</b>	Describe the suggested change(s) or comment
<b>Response</b>	State if the change was/is being applied/rejected/being discussed
<b>CDC Code</b>	<p>CDC Code: Input an ‘r’, ‘g’, or ‘y’ in the space to indicate the status of the iteration</p> <p><b>Red</b>: the iteration was rejected</p> <p><b>Green</b>: the iteration has been applied</p> <p><b>Yellow</b>: the iteration is either in the process of being applied or being discussed as to how to proceed</p>
<b>Completed</b>	Place an ‘X’ to indicate the iteration has been addressed; the row will then be grayed out

**Guide for research study iterations**

Below are the guidelines for research study or intervention design iterations. The guidelines correspond to the “TechSAge Tool Research Study Iteration Tracking” excel template. The excel template and example files are available from authors on request. The template column names, descriptions, and examples are presented in Table 2. Examples of study phases and components are presented in Table 3.

**TABLE 2. TECHSAGE TOOL RESEARCH STUDY ITERATION TRACKING EXCEL TEMPLATE DETAILS**

Column Label	Description
Issue/Recommendation	Describe the suggested change(s) or comment
Date	Date that the suggested change was recommended
Phase of Study or Intervention	Indicate if the change was suggested for: <ul style="list-style-type: none"> <li>- Pre-Intervention</li> <li>- Post-Intervention</li> <li>- During Intervention</li> </ul>
Component of the Study or Intervention	Indicate what aspect of the study the change relates to <ul style="list-style-type: none"> <li>- Prescreen, Intervention, Recruitment, Tools, IRB, Participant, Interviewer (see Table 3 for more in-depth examples)</li> </ul>
Source	Indicate the source of recommendation <ul style="list-style-type: none"> <li>- Participant</li> <li>- SME (Subject matter expert)</li> <li>- Literature Search</li> <li>- Adverse Event</li> <li>- Study attrition</li> <li>- Other</li> </ul>
Response	State that the change was/is: applied/rejected/ or being discussed
If modified, date implemented	If the change was accepted, insert the date the change was applied
If modified, describe change	Describe the change/modification
CDC Code	CDC Code: Input an 'r', 'g', or 'y' in the space to indicate the status of the iteration <b>R Red</b> : the iteration was rejected <b>G Green</b> : the iteration has been applied <b>Y Yellow</b> : the iteration is either in the process of being applied or being discussed as to how to proceed
Completed	Place an 'X' to indicate the iteration has been addressed; the row will then be grayed out

**TABLE 3. RESEARCH STUDY OR INTERVENTION STUDY PHASE EXAMPLES**

<b>Phase/Component</b>	<b>Description</b>
<b>Recruitment</b>	Added/removed recruitment strategy Added/removed requirement criteria
<b>Screening</b>	Added/removed a measure or question Changed eligibility requirement Increased pass requirement Decreased pass requirement
<b>Enrollment</b>	Changed enrollment timeline
<b>Protocol</b>	Changed content or protocol Added/removed a measure or question Changed protocol order Changed wording in interview or questionnaire Change in response options
<b>IRB</b>	A change was approved by IRB
<b>Equipment</b>	Adding or removing equipment or technology (or software update) to task performance
<b>Participant</b>	Adverse event Dropped from study
<b>Payment</b>	Incentive change
<b>Research Staff</b>	Change in interviewer/assessor/Interventionist
<b>Add new phase, if needed...</b>	

In the case of an intervention adaptation, each aspect of the intervention should be deconstructed into its phases (i.e., recruitment, staffing, training, scheduling, intervention content, assessment) and the tracking tool should indicate how each phase was carried out in the original intervention and how each phase will be implemented in the adapted version. Any iterations made while the intervention is in progress should be indicated as well.

## **WORKING WITH OLDER ADULTS WITH DISABILITY**

To reach a large and diverse group of end users and research participants, user centered design should embody inclusion. Ideally, inclusion should start during the development and design process. By including individuals with disabilities early on, designs will be able to be more accessible for a wider audience. However, user centered design does not typically include a disability focus (Shinohara, Bennett, Pratt, & Wobbrock, 2018). Individuals with disabilities, let alone those aging with disabilities, are often excluded in the design of products. These individuals are often not considered in the design of research studies, as well.

Some design guidelines have been developed that do take into consideration a diverse range of abilities and disability, including Universal Design: 7 Principles (Mace, 1997) and 7 Principles of Ability-Based Design (Wobbrock, Kane, Gajos, Harada, & Froehlich, 2011). The seven principles of Universal Design were originally designed as a universal framework for working spaces and have since been applied to product design as well (see Table 4).

**TABLE 4. UNIVERSAL DESIGN PRINCIPLES**

Principle	Description
Equitable Use	The design is useful and marketable to people with diverse abilities.
Flexibility in Use	The design accommodates a wide range of individual preferences.
Simple and Intuitive Use	Use of the design is easy to understand, regardless of the users experience, knowledge, language skills, or current concentration level.
Perceptible Information	The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
Tolerance for Error	The design minimizes hazards and the adverse consequences of accidental or unintended actions.
Low Physical Effort	The design can be used efficiently and comfortably and within a minimum of fatigue.
Size and Space for Approach and Use	Appropriate size and space is provided for approach, reach, manipulations, and use regardless of user's body size, posture, or mobility.

There are also seven principles of Ability-Based Design (see Table 5). The stance category focuses on what a person can do as opposed to thinking about what they cannot do. Interface brings attention to the ability of the design and making sure the user's abilities are a focus. Finally, the system category has a focus on the users' actions and predicting those actions. The following table illustrates the seven principles and the category to which they belong (Wobbrock et al., 2011). Also, the table presents descriptions of each principle.

**TABLE 5. 7 PRINCIPLES OF ABILITY-BASED DESIGN**

Principle (Category)	Description
<b>Ability (Stance) Required</b>	Designers will focus on ability not dis-ability, striving to leverage all that users can do.
<b>Accountability (Stance) Required</b>	Designers will respond to poor performance by changing systems, not users, leaving users as they are.
<b>Adaption (Interface) Recommended</b>	Interfaces may be self-adaptive or user-adaptable to provide the best possible match to users' abilities.
<b>Transparency (Interface) Recommended</b>	Interfaces may give users awareness of adaptations and the means to inspect, override, discard, revert, store, retrieve, preview, and test those adaptations.
<b>Performance (System) Recommended</b>	Systems may regard users' performance, and may monitor, measure, model, or predict that performance.
<b>Context (System) Recommended</b>	Systems may proactively sense context and anticipate effects on users' abilities.
<b>Commodity (System) Encouraged</b>	Systems may comprise low-cost, inexpensive, readily available commodity hardware and software.

More information and examples of Ability-Based Design can be found in the resources section of this tool: 'Ability-Based Design'.

An additional approach, user-sensitive inclusive design (Newell, Gregor, Morgan, Pullin, Macaulay, 2011), highlights some considerations that should be accounted for when involving those with disability in the design process, such as difficulty getting informed consent, difficulty or inability for the user to communicate their thoughts. Applying these universal design practices benefits usability for those with disabilities, as well as users without disabilities. By integrating inclusive design ideals, product developers can gain advantages such as having to make fewer design iterations and thereby saving time. When iterations are made to accommodate a particular user groups needs, it should be documented in the design iteration tracking sheet.

## **METHOD SECTION EXAMPLE**

Below we provide example text for how a design iteration approach can be described in the method section of a journal article.

### **Product Design Iterations**

We tracked each recommended design change and used the adaptation traffic light to determine which changes should be implemented (Firpo-Triplett & Fuller, 2012; Rolleri et al., 2014). Red-light changes were those that could not be made, such as those due to a software or hardware limitation. Green-light changes, such as increasing the font size, were made. Yellow-light changes were those in the process of being implemented.

### **Intervention Design Iterations**

This research study implemented a rapidly executed iterative design intervention. We tracked each recommended or required design changes and used the adaptation traffic light to determine which changes should be implemented (Firpo-Triplett & Fuller, 2012; Rolleri et al., 2014). Red-light changes were those that could not be made because they might decrease the effectiveness of the intervention, such as substantially shortening the program or deleting activities. Green-light changes, such as creating a different branding or improving the readability of interview questions were freely made. Yellow-light changes were those that were considered with caution because there was a chance that they could decrease intervention effectiveness; yellow-light changes were reviewed by [adaptation committee, program developer, advisory board].

## **SUMMARY**

This TechSAge tool, although not comprehensive, was designed to be a helpful guide to illustrate the general concept of design iteration tracking. Specifically, we focused on tracking iterations for product development and research protocols. This tool has discussed the usefulness of the iteration process and described an external document to help guide tracking of design iterations. Two external documents (available upon request from first author) were developed, depending on the type of design (research or development) to help guide the tracking of iterations.

This tool has also provided information on the importance of designing with a wide range of users in mind to reduce the possibility of larger, potentially more time-consuming iterations later in the design process. By testing the methods and/or device in the beginning stages with a diverse set of target populations, researchers and developers are able to save time and potentially money by identifying different barriers along the way—all while keeping track of the reasons why changes were made.

## RESOURCES

### Useful Websites

Ability-Based Design Guidelines

<https://www.eecs.harvard.edu/~kgajos/papers/2011/wobbrock11abd.pdf>

Iterations in the Design Process

<https://blog.prototypr.io/iterations-in-the-design-process-41bd8d01f244>

Guidelines for Designing for Persons with Disability

<http://universaldesign.ie/What-is-Universal-Design/The-7-Principles/>

Design for User Empowerment

<https://interactions.acm.org/archive/view/march-april-2015/design-for-user-empowerment>

Universal Design: 7 Principles (Mace, 1997). Detailed information on the guidelines can be found here

<http://universaldesign.ie/What-is-Universal-Design/The-7-Principles/>

## REFERENCES

- Eppinger, S. D., Whitney, D. E., Smith, R. P., & Gebala, D. A. (1994). A model-based method for organizing tasks in product development. *Research in Engineering Design, 6*(1), 1–13. doi: 10.1007/bf01588087
- Firpo-Triplett, R. & Fuller, PT. R. (2012). *A Guide to Adapting Evidence-Based Sexual Health Curricula*. Centers for Disease Control and Prevention. <https://www.etr.org/ebi/assets/File/GeneralAdaptationGuidanceFINAL.pdf>
- Guo, F., & Gershenson, J. K. (2004, September 28–October 2). *A comparison of modular product design methods based on improvement and iteration*. Paper presented at ASME 2004 Design Engineering Technical Conferences and Computers and Information in Engineering Conference, 3a:16th International Conference on Design Theory and Methodology, 261-269. doi:10.1115/DETC2004-57396
- Newell, A. F., Gregor, P., Morgan, M., Pullin, G., & Macaulay, C. (2011). User-Sensitive Inclusive Design. *Universal Access in the Information Society, 10*(3), 235–243. doi: 10.1007/s10209-010-0203-y
- Mace, R. (1997). The 7 Principles. Retrieved from <http://universaldesign.ie/What-is-Universal-Design/The-7-Principles/>.
- Rolleri, L. A., Fuller, T. R., Firpo-Triplett, R., Lesesne, C. A., Moore, C., & Leeks, K. D. (2014). Adaptation Guidance for Evidence-Based Teen Pregnancy and STI/HIV Prevention Curricula: From Development to Practice. *American Journal of Sexuality Education, 9*(2), 135–154. doi: 10.1080/15546128.2014.900467
- Shinohara, K., Bennett, C. L., Pratt, W., & Wobbrock, J. O. (2018). Tenets for Social Accessibility. *ACM Transactions on Accessible Computing, 11*(1), 1–31. doi: 10.1145/3178855
- Unger, D., & Eppinger, S. (2011). Improving product development process design: a method for managing information flows, risks, and iterations. *Journal of Engineering Design, 22*(10), 689–699. doi: 10.1080/09544828.2010.524886
- Wobbrock, J. O., Kane, S. K., Gajos, K. Z., Harada, S., & Froehlich, J. (2011). Ability-Based Design. *ACM Transactions on Accessible Computing, 3*(3), 1–27. doi: 10.1145/1952383.1952384