

Chapter 6. Task Analysis

Section 6.1. Setting the Stage

Once data have been collected in the field, you will need a way to make sense of the data, and to share it in a meaningful way with others. Completing a task analysis can be extremely helpful in accomplishing both of these goals. Taking the time to package your data into a task analysis format is an effective way of systematically identifying any assumptions being held, or any gaps in your own understanding.

Section 6.2. What is Task Analysis

A task analysis is a data documentation and analysis tool used to document the specific tasks of a process, a workflow, according to its constituent steps. Task analysis essentially decomposes an activity into smaller steps to analyze the sequence, conditions and performance criteria for completing a task.

Many frameworks and approaches to task analysis exist, with a comprehensive review included in Kirwan and Ainsworth 1992 [31]. Observational, interview, focus group, and survey data can all serve as inputs for a task analysis. The output of a task analysis is usually a diagram and/or a description of the individual steps required to carry out a workflow or process to complete a defined goal. In turn, this diagram often becomes an input for other human factors methods like heuristic analysis, usability testing, ^{HF}FMEA, or ^{HF}RCA.

Section 6.3. Why use Task Analysis

A task analysis is an excellent way to consolidate data from multiple sources, such as through observations, or interviews, focus groups, and surveys, and can serve as a framework for linking artefacts and photographs collected in the field to specific parts of the processes related to the technology being studied. Organizing your data in this way will help you to identify any gaps or uncertainties in your knowledge to ensure you have a clear understanding of the work that is being undertaken by staff.

Completing a task analysis will encourage the biomedical technology professional to:

- Systematically think through the actions and thought processes required of a subject in order for them to achieve a defined goal.
- Consider the boundaries of the defined workflow or process, and the relationships among different tasks.
- Define the scope of a system, process or problem.

- Think about the order in which tasks are completed, the required and available information at each task step, and how a subject proceeds from one task to the next to achieve their overall goal.
- Identify the conditions (knowledge, tools, etc.) and performance criteria for successfully completing each task step and the ultimate task goal.

In the context of health technology safety, the goal of a task analysis is to assess whether the demands being placed on the users of a technology are within the normal range of human capabilities, and if there are risks (human factors or other) associated with any of the tasks that can be mitigated. All the tasks described above will support the biomedical engineering professional in developing recommendations for task design/redesign and developing more effective procedures and instructions for use. They will also serve as the backbone for further human factors evaluation methods.

In addition to serving as input for other human factors methods, the output of a task analysis is helpful for communicating your understanding of the system to others. Often when processes are displayed step by step, as in a task analysis, even those intimately familiar with the documented process are surprised at just how many discrete steps are involved. A task analysis can be a catalyst for simplifying a workflow or process because when viewed diagrammatically, you may see entire branches or sections of the diagram that are not required to achieve the system goal. Thus, task analysis can help you to identify opportunities to optimize how work goals are achieved, with the ultimate aim of providing safer and more efficient care.

From the biomedical technology professionals' perspective, completing a task analysis will be helpful for:

- Consolidating, and organizing data from observations, interviews, focus groups, and surveys
- Highlighting any gaps in your understanding of a workflow or process that require further data collection in the field
- Making complex healthcare processes, workflows, and user interactions with technologies more understandable by breaking them down into smaller, more manageable parts
- Informing other human factors methods like heuristic analysis, usability testing, ^{HF}FMEA, and ^{HF}RCA

Section 6.4. When to Use Task Analysis

After you have collected observational, and interview, focus group, and/or survey data from the field, it can be consolidated, organized, and documented using a task analysis. The output of a task analysis can be an excellent communication and collaboration tool, so

if you would like to share your data with others, or get confirmation or clarification about what you learned in the field, this form of documentation and analysis is highly recommended. A task analysis should be completed prior to conducting an ^{HF}FMEA, ^{HF}RCA, and if desired, prior to a heuristic analysis or usability test.

Section 6.5. In Preparation for a Task Analysis

In preparation for a task analysis, the biomedical technology professional should spend time observing in the field ([Chapter 4](#)) to collect data that will serve as the basis for the task analysis. If applicable, interviews, focus groups, and/or survey should also be completed to serve as additional data sources ([Chapter 5](#)).

Once data have been collected it is a good idea to revisit the objectives of the project to get you thinking about the purpose and scope of your task analysis. Next, a framework should be chosen. There are several task analysis frameworks available, and the one you choose will depend on the purpose of doing a task analysis. Of note are the Decision-Action Diagram, or Activity Diagram; Hierarchical Task Analysis (HTA); Cognitive Task Analysis; Critical Incident Technique; and Link Analysis. A comprehensive review of the various task analysis frameworks are included in Kirwan and Ainsworth 1992 [31].

For the purposes of this book a single task analysis framework will be presented: the process flow diagram. The process flow diagram is likely to be the most useful task analysis framework for a biomedical technology professional because it is a flexible means of describing a wide range of workflows and processes. Typically, process flow diagrams are comprised of standardized shapes and arrows that represent tasks, and the flow between tasks, respectively. They provide a means of documenting actions, decisions, information flow and activities. In terms of notation for a process flow diagram, the Unified Modeling Language (UML) 2.0 is recommended because unlike most other notations, this graphical language allows the analyst to document activities occurring in parallel, which is a common occurrence in healthcare. An example of the output of a process diagram is shown in [Figure 9](#).

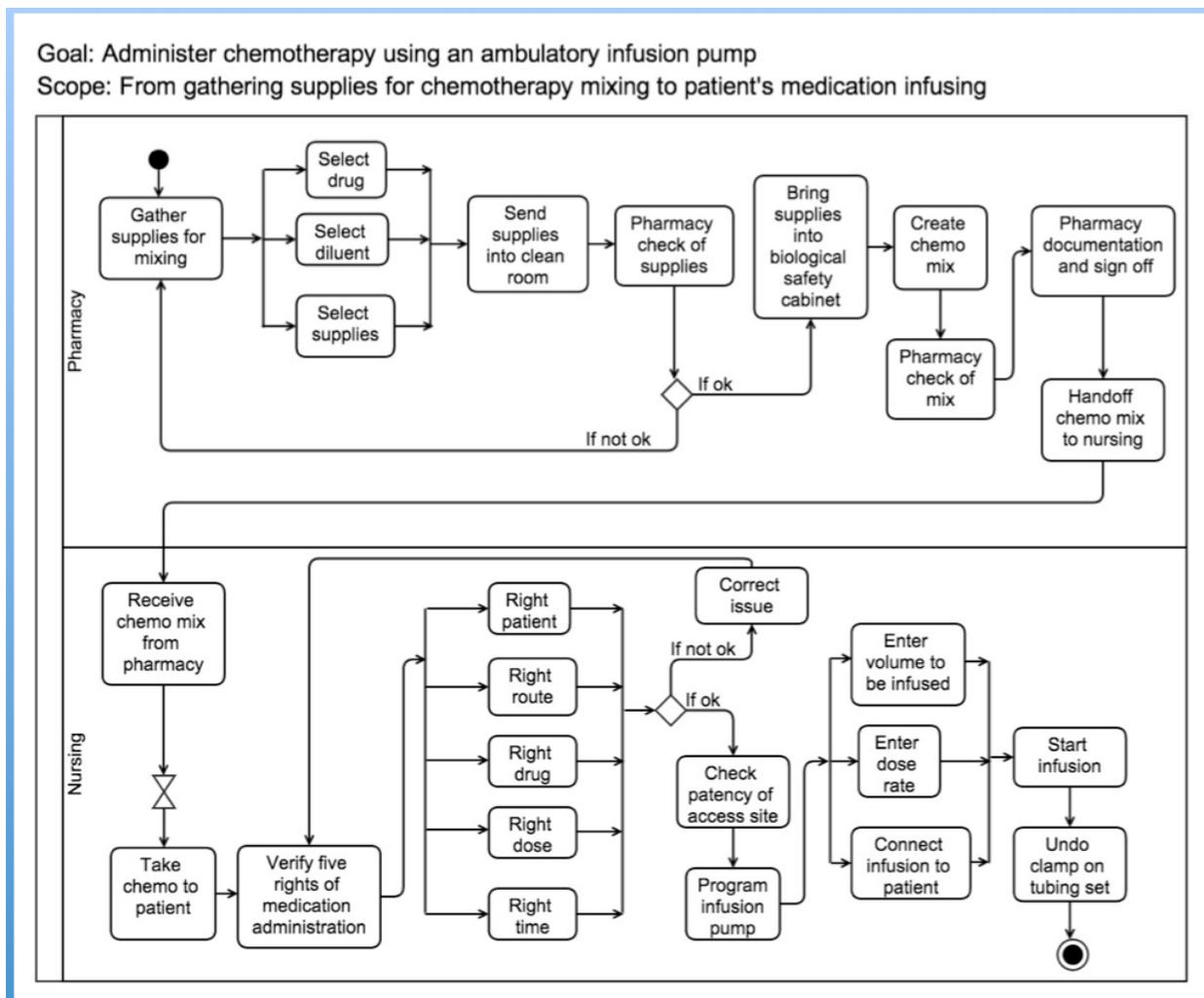


Figure 9. Example of a process flow diagram

In preparation for creating a process flow diagram, you will need to have access to the data collected in the field, including any notes, photographs and other artefacts, and either a large piece of paper and a pencil, or a computer program with diagramming capability. In terms of computer programs there are several options available, ranging from open source to professional suites. When selecting a computer program for your task analysis, ensure it can be used to create flowcharts. A program with a UML library is ideal because it allows you to easily drag and drop the boxes and arrows needed to represent the elements of a process flow diagram.

Section 6.6. Completing a Task Analysis

The first step when creating a process flow diagram is to define the goal and scope of the workflow or process being considered. Outlining the goal of the workflow will ensure the diagram covers the process of interest, especially when a process spans multiple clinical areas, and defining the scope of the workflow will provide the boundaries of the

diagram. In the case of the example in [Figure 9](#), the process goal is administering chemotherapy using an ambulatory infusion pump, and the process scope ranges from gathering supplies for chemotherapy mixing to the patient’s medication infusing. Tasks that occur upstream and downstream of this scope (e.g., preparing chemotherapy order and discontinuing the pump after the medication is infused) are not included in the task analysis and are therefore not shown on the process flow diagram.

Determining what constitutes a task takes a bit of practice. One way to consider tasks is to think of them as a subject/verb/noun grouping. Essentially who does what action with/on what object. For example, a *nurse(subject) draws the diluent (verb) from the vial (noun)*. Some people may find it helpful to create a list of tasks in a tabular format before moving to a process flow diagram. [Figure 10](#) provides an example of what a task table could look like.

Major Tasks	Sub-tasks	Conditions	Completion Criteria	Design	Instructional Consideration
1. Pharmacy technician (PT) mixes Chemotherapy	1.1 PT reviews chemotherapy order	1.Order verified in electronic order system. 2. patient blood work is complete	1. Blood work results are consistent with criteria for receiving chemotherapy		1. PT must know how to find blood work criteria for specific protocol ordered for the patient.
	1.2 PT gathers supplies	1. Containers for storing each patients medications are cleaned from previous use.	1. All materials needed for the mix are in the storage container.	Baskets need separate compartments so bottles don't bang together	

Figure 10. Tabular list of tasks and subtasks that help to organize information prior to creating a process flow diagram.

Each of the graphical symbols of a process flow diagram are described in this section and shown in [Figure 11](#). The starting point of the process flow diagram is the “initial node”: a box representing the first task in the process. From here, subsequent task steps are documented in boxes joined with arrows that indicate the sequence of the actions/decisions/information flow associated with the process goal and within the defined process scope. A “fork” and “join” are used in combination to indicate activities that may occur at the same time or in any order, with the stipulation that all activities must be completed before moving beyond the join. A “decision point” is indicated with a diamond, where only one of the available paths will be followed. To determine which path to follow

at a decision point, “decision criteria” are included to show the conditions under which that path should be taken. When either an elapsed time, or time to initiate an action is relevant, a “passing time” symbol is used. A “swim lane” is used to separate tasks that take place either in different clinical areas, or that are done by different people. Lastly, a “final node” is used to indicate the end of the process scope being diagrammed.

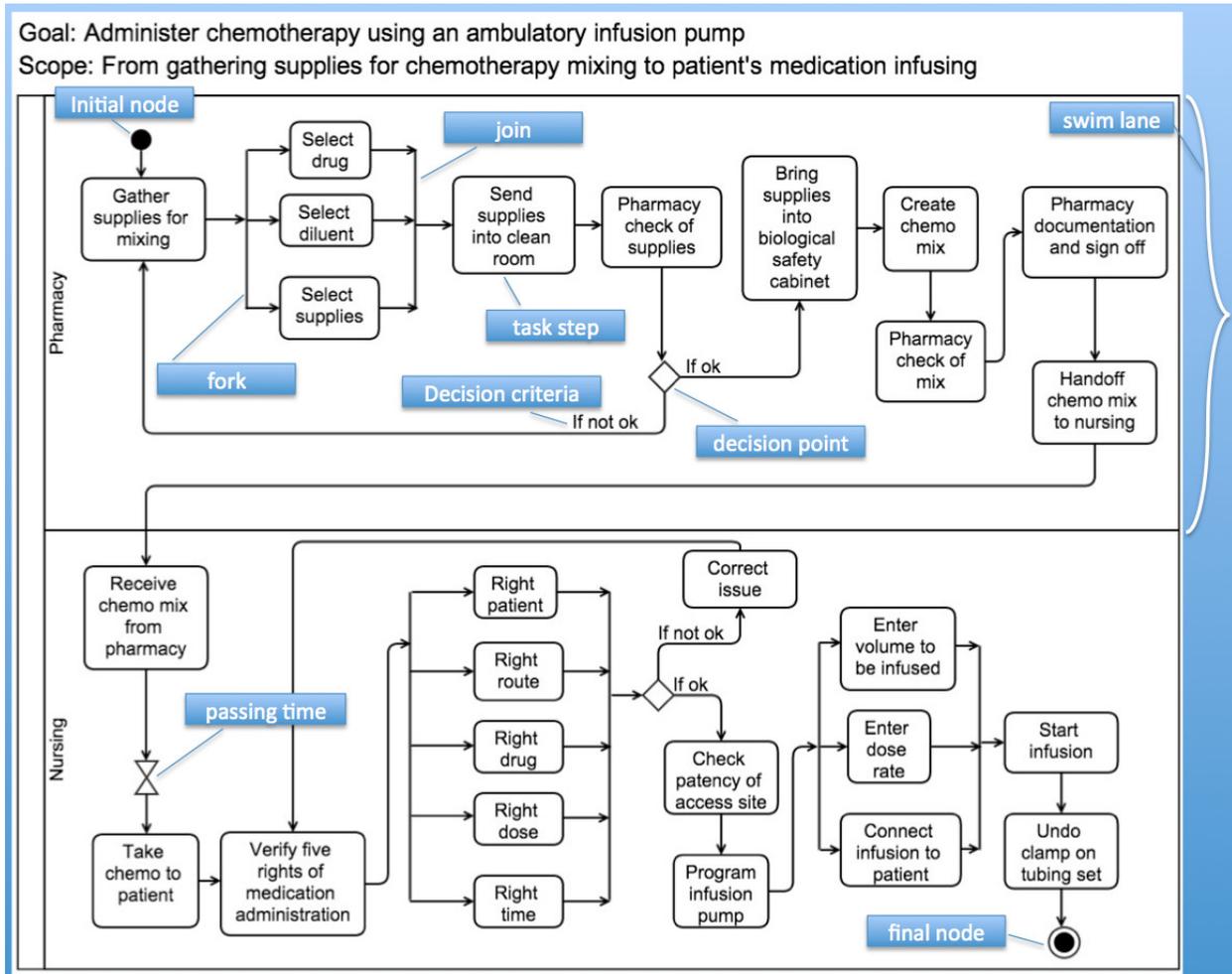


Figure 11. Process flow diagram with defined symbol types

As you work through adding nodes to the process flow diagram, refer to the data collected through your observations, or interviews, focus groups and surveys. If there is uncertainty surrounding a task step, it is important to make note of this and then to conduct targeted data collection activities to resolve the uncertainty and reflect the findings on the process flow diagram. Creating a process flow diagram is an iterative process, and it is normal to make a first draft of the diagram, to have gaps and questions about the process, and then to gather additional information to support an accurate diagram. One of the main challenges when creating a process flow diagram is knowing how much detail to include (see [Section 6.8](#) Limitations of Task Analysis). To assist in creating a

diagram at an appropriate level of detail keep in mind the purpose and resources available for the task analysis. Asking the question “does this task or sub-task fall within the defined goal and scope for this workflow” is another means of helping you to determine whether a task or subtask should be included.

Section 6.7. What to do with a Completed Task Analysis

A completed task analysis is required as an input to other human factors methods such as ^{HF}FMEA, ^{HF}RCA. It may also be used to help inform a heuristic analysis or usability test. Even if no further human factors analyses are to be conducted, a task analysis on its own can be an invaluable analysis and communication tool, especially to understand a process and to illustrate the complexity of a process to others. It can also inform development of procedures to compensate for poor design and is used to develop new processes when changing workflow or moving to a new building or workspace. Being able to see how different clinical units interface with one another adds a new and useful perspective.

Section 6.8. Limitations of Task Analysis

Although task analysis can be an extremely useful exercise, there are some limitations and common pitfalls to be aware of.

Section 6.8.1. The Time Investment Required

A task analysis is an iterative undertaking that requires several rounds of editing and updating as stakeholders review and provide feedback, based on their perspectives. It is important to include stakeholders who are involved in the process being documented as reviewers of your analysis and ask them to provide feedback to ensure your documentation is as accurate as possible. With practice, you will become more efficient at documenting and describing workflows or processes based on the data you have collected in the field.

Section 6.8.2. Knowing What Data to Include

A common pitfall when conducting a task analysis is knowing what data to include in the diagram or process description, both in terms of which content to include, and how detailed to be. This determination will partially depend on the content of the data you have to work with, as well as the goals of the task analysis, and project itself. Usually, actions that can be considered “constant” in that they would be required of any person in that role to achieve the defined goal, should be included in the task analysis. Actions that can be considered “context specific”, in that the subject you observed did something that was not related to the defined goal, should generally not be included in the task analysis. [Figure 12](#) includes an example for further clarification.

A nurse is preparing to administer chemotherapy to a patient using an ambulatory infusion pump, and you observe her do the following:

- Pick up the chemo from the pharmacy
- Talk with a nurse about another patient
- Take the chemo to the patient
- Verify the five rights of medication administration
- Answer a patient's question about side effects
- Check the patency of the patient's access site
- Program the infusion pump by entering the volume to be infused and the dose rate
- Connect to the patient
- Start the infusion
- Undo the clamp on the tubing set

You would want to include the following tasks in your task analysis:

- Pick up the chemo from the pharmacy
- Take the chemo to the patient
- Verify the five rights of medication administration
- Check the patency of the patient's access site
- Program the infusion pump by entering the volume to be infused and the dose rate
- Connect to the patient
- Start the infusion
- Undo the clamp on the tubing set

And you would want to exclude the following tasks from your task analysis:

- Talk with a nurse about another patient
- Answer a patient's question about side effects

The context specific tasks (talk with a nurse about another patient and answer a patient's question about side effects) should not be included in your task analysis because they do not directly lead to the process goal, of *administering chemotherapy to a patient using an ambulatory infusion pump* and thus would not have to be carried out by every person in this role.

Figure 12. Deciding what data to include as part of a task analysis

In terms of the level of detail to include, this will mostly depend on the purpose of the task analysis and the resources available. The larger the scope and more detailed the task analysis, the longer it will take to document. Not including enough detail in a task analysis, however, can lead to making assumptions about the process and a failure to

identify potentially problematic tasks, as well as possible opportunities for making improvements.

Section 6.8.3. Failing to Document the Actual Process

Another common pitfall with task analysis is failing to document the actual process followed by users of the technology, and documenting the ideal process instead. In healthcare it is common for work practices to change over time as a result of external time and cost pressures as well as changes to other components of the environment, and this means that people become creative and look for shortcuts, workarounds and new ways of accomplishing their goals. When a task analysis is completed for the ideal workflow or process, it often fails to capture the actual tasks that are being done, and it will not be an accurate, or useful description of what is truly happening in the field. A task analysis of the ideal process also limits its usefulness as an input for other human factors methods.

Additionally, there is often variability in how tasks are performed and this too needs to be captured in the task analysis.

For this reason it is extremely important to collect data using observations in the field rather than assuming staff are operating according to a policy or protocol. Although unintentional, it is common for people to describe what they do differently than how it is done in reality, because of limitations on memory and attention and cognitive biases ([Chapter 3](#)), and so interview, focus group, and survey data, although important, should always be supported by observational data prior to conducting a task analysis.

Section 6.9. Additional Task Analysis Resources

Articles:

- Human factors in anaesthetic practice: insights from a task analysis. *British Journal of Anaesthesia* 100 (3): 333–43 (2008) <http://bj.oxfordjournals.org/content/100/3/333.full.pdf>
- [Vasilakis, C., Leczarowicz, D., Lee, C., Application of unified modelling language \(UML\) to the modelling of health care systems: An introduction and literature survey. *International Journal of Healthcare Information Systems and Informatics*, 3\(4\), 39-52 \(2008\)](#)

White Papers:

- Embrey D, Task Analysis Techniques. 2000. Human Reliability Associates Ltd. Available at: <http://www.cwsvt.com/Conference/Functional%20Assessment/Task%20Analysis%20Techniques.pdf>

Book Chapters:

- Fowler M, UML distilled third edition: A brief guide to the standard object modeling language: Chapter 1, Introduction. Third Edition ed., pp 1-16. Addison-Wesley, 2004

Books:

- Kirwan B, Ainsworth LK. A Guide to Task Analysis. London: Taylor & Francis, 1992