Targets Metrics and Functions

Now that the fundamental functions of our system have been broken down, metrics can be used to validate and quantify the functions specified. For example, the function of software will usually be given metrics like speed, storage, and accuracy. To accompany these metrics, targets are used to give specific values to the metrics. Looking at Figure 1 below, the functions of the system have been broken down. With this information we are to relate each function with a target and a metric.

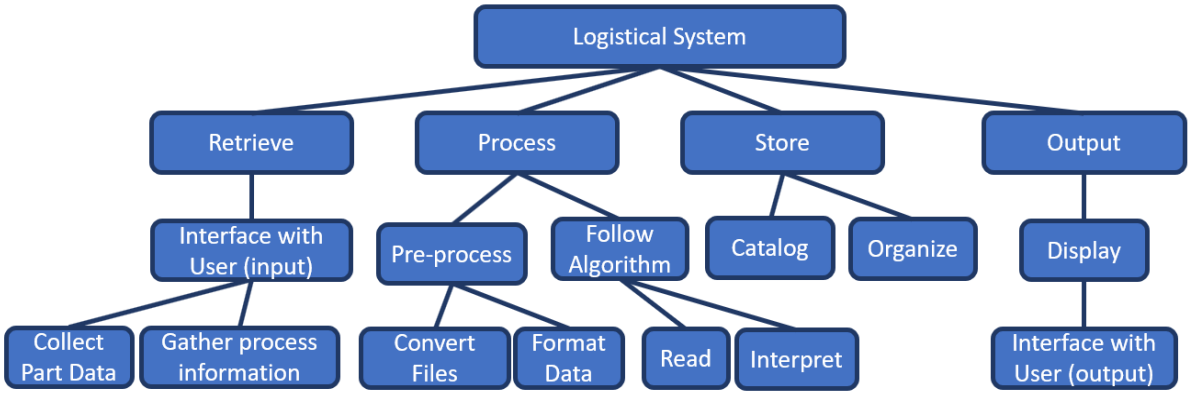

Figure 1: Functional Decomposition Flow Chart

Derivation and Validation of Targets and Metrics:

Functions and subfunctions were broken up into targets and metrics in order to assess how each of the functions will be validated.

Retrieve:

The first function, retrieve, was broken up into 4 sub functions: collect part data, interface with the user, gather part information, and gather process information. In order to properly collect part data, the metric of storage capacity was assigned. The target is to achieve a total file input size of $0 < x < 10$MB, where x is the size of the input file(s). This metric ensures two things. First, if the file is non-zero, that ensures that there is some part data that has been obtained. Second, this ensures that the operating system used by Danfoss is able to handle the

file size. A target of 10MB ensures that the computational speed will not be too long and prevents the system from crashing due to overflow. This target was derived by taking the largest file we may be expected to work with (2MB) and multiplying that by a safety factor of 5. This gives us 5 times the assurance that our solution will be able to run effectively and be able to handle unconventionally large file sizes if needed.

Next, is the sub function "interface with user." This function was broken down into two metrics: ease of use, and aesthetic appeal. Ease of use will be measured by the number of clicks required upon opening the system on the user's operating system. This was derived with a view to reducing the amount of effort required by the user. The second metric, "aesthetic appeal" is measured using a customer satisfaction survey (see Appendix D). This survey will have a 1-5 scale where 5 represents an excellent user interface and 1 represents a poor one. The customer survey will also include a survey with comments to give Team 504 feedback on what can be improved for future versions. This metric was written with a view to achieving a 5 on the customer satisfaction survey with positive feedback in the comments. This target was derived to gauge whether the customer needs have been satisfied to their standard.

The final sub functions include gathering information in the form of part data and process data. Both of these functions can be validated using the same metric by employing a kind of ratio, that is the ratio of information obtained to the ratio of information needed. The information obtained can be found by using a simple count function in excel. The information needed will be obtained by coordinating with Danfoss to ensure the correct amount of information needed is represented in the system. This also can be found using the count function in excel to ensure no human error in counting. This target associated with this metric is 1 as ideally the system should have all the information it needs to make decisions on part

data. However, in the world of manufacturing, all of this data is not always readily available and is dependent on the information given to the planners from testing. A separate process will need to be implemented in order to ensure that this information is obtained correctly and will be validated by a separate metric discussed later in the document. This metric was designed with a view to quantifying how much data the system has at its disposal to make accurate decisions. However, the system should still function even if the ratio is not equal to 1.

Process:

The second function process was broken down into 6 subfunctions: convert files, format data, follow the algorithm, interpret, read, and organize code. In order to accomplish the global function of processing, the system needs to be able to process at a certain speed. This was broken down into two targets. Based on research of optimum processing speed for typical software and program files, the target of 3.0 GHz was assigned. Coupled with the processing speed target is the amount of time the system actually takes in order to run the script. Knowing these two pieces of information will provide information on how long the system takes to run on different CPUs with different processor performance specifications. The system processing time target was assigned a value of 2 min. This was designed in an effort to increase the ease of use so the customer would not need to wait for a long time to get the information they need to continue. A conservative value of 2 min was chosen to account for the possibility of large file sizes.

The first subfunction, convert files, was assigned the metric “file conversion accuracy.” This metric will be checked manually by a member of team 504 to ensure that the converted file contains the same information and ordering system as the original file. This target is binary,

either 1 or 0, where 1 represents success and 0 represents failure. Upon completion of this task for every possible input file given to the system, this metric would be considered satisfied as file conversion has been standardized and is considered a mature field in the software community.

The second sub function, format data, was assigned the metric "data format accuracy." This metric will also be defined by a manual check using the same methodology as that of "file conversion accuracy" by checking to see if all the files and rows have been moved to their correct locations. This metric will also need to ensure that upon re-arrangement of the information, the data is still the same and representative of the file from which it came. Like file conversion accuracy this target will be binary, either a 1 or a 0 where 1 represents success and 0 represents failure. Upon completion of this task for every possible case the system may encounter this task will be considered complete. This is because once the file has been organized correctly once and has been checked for each possible case, the system will follow the same logic every time and there is no need to continuously check this. The assumption that we are making with this metric is that places from which we draw this data are static, not changing with time. If the file types, or file ordering scheme change, then the system will need to be reconfigured to account for these changes. This will be part of the process creation step of this project and this assumption has been confirmed to be within the liberty of what Team 504 is allowed to impose on the testing team.

The third and fourth subfunctions, follow algorithm and interpret, are both satisfied by the metric of part conversion efficiency. Part exchange efficiency is defined as the ratio of parts exchanged correctly to the total number of parts exchanged. The target will be set to 1 as ideally, the system will be able to successfully exchange parts 100% of the time. This target is governed by the ratio of information obtained to the information needed from the previous section. This is

due to the fact that if not all the information needed is present, the system will not be able to accurately predict all of the part replacements. This target (part exchange efficiency) was designed to account for the need of quantifying how good the system is at exchanging parts correctly. This target will be validated by comparing the bill of materials produced by the system with the final bill of materials produced at the end of the production phase of the manufacturing process. This information is contained in the catalogs given to us by Danfoss.

The fifth subfunction, read, is measured by the metric "reliability." This metric is defined as the ratio of system failures to the number of system successes. This data will begin to be obtained from the moment the product is released to the customer indefinitely. This information will be stored internally and will be displayed upon request from the user. This metric will be assessed by using a simple count function within the processing function of the system. The system will count the number of times the system has been run and compare it to the number of times it has successfully run. A successful run is defined as a run with no error messages or bugs. The target for this metric is 93% success rate which will be discussed in more detail in the store section of the document.

The final subfunction, organization of code is represented by the metric code complexity. Code complexity will be defined by the customer satisfaction survey and will be measured on a 1-5 scale the same way as the aesthetic appeal is measured (see Appendix D). This metric was derived with a view to quantifying how readable, organized, and reproducible the systems code is. This satisfies the customer's need for adaptability.

Store:

The third main function “store” has two subsections: catalog and organize. In order for our system to operate our system needs a way to store the data. With the function store, the metric used to measure this function is storage capacity. The target associated with this is $0 < x < 10MB$. Since this is the size of the input file given to our system, the system should also be capable of storing this amount of data. Per information given to us from Danfoss, it is known that their computing resources are not limited and there is not a realistic ceiling for how much data storage will be available to the system. However, this metric was established with a view to processing speed and reliability. This target was derived the same way that “storage capacity” was defined and can be considered to be cross-functional with collect part data.

The sub function “catalog” needs to be able to store these files in the correct location. The metric that validates this function is reliability and is measured by the target of a 93% average success rate. This average success rate was measured by benchmarking an Apple iPhone7 which has the same average success rate of 93%. This is also dependent on the accuracy of the algorithms in the system. The iPhone 7 is considered to be a good standard. This reliability measurement can be considered to be the same as the reliability metric in the process section of the document. In other words, the sub function “read” can be considered cross-functional with “store.”

Output:

The final main function output was broken into two primary subfunctions: display and interface with user. Both of these subfunctions are satisfied by targets previously specified in the document. Display is satisfied by the customer satisfaction survey corresponding to the metric of aesthetic appeal. To ensure that the information is displayed accurately, all of the previous

metrics will be outputted to the system display. Since the accuracy of the display is contingent on the accuracy of the underlying metrics, this metric is already quantified by the underlying metrics and can be considered obsolete. Also this metric can be implicitly defined by the system reliability. The system reliability can be considered to be cross functional with the read, catalog, and display functions. The interface with user function can be defined by the previously stated metric “number of clicks.” This is to say that the input and output of the system can be considered cross-functional: one and the same in terms of metrics.

Discussion of Measurements:

In order to verify the systems' metrics and validate the targets, a mix of data and resources will be used as tools to serve as indicators. For measuring storage capacity, processing speed, file conversion, and file location accuracy a Danfoss operating computer or a computer that matches the system’s specs will be the primary tool to validate such metrics, while task manager, MATLAB, and data centers will be the main sources to check if the targets match their respective metric. Other metrics such as data format accuracy, part conversion efficiency, and reliability will also be measured within a computer but will be rated to match their target by the program Danfoss computers have for the inspection, planner, and material handler teams. Finally, metrics that deal with ease of use, aesthetic appeal, ratio of obtain to needed information, code complexity, and organization difference will be measured based on feedback of Danfoss’ planning team, making surveys as the main tool to measure such metrics.

Critical Targets and Metrics:

All the metrics in our system can be boiled down to storage, accuracy, and speed. However, the critical metrics in our system will be storage and reliability. Being that our solution will involve software, storage and reliability are imperative so that the system can work. If the data files are too big to enter the system, it will fail at that instant. If the algorithm we run has bugs, then the systems will stop running. The assumption is that the data going into the system will be around a 2 MB, so the target was made 10MB. This was done with a factor of safety of 5 to ensure that our system will be able to compute that amount of data. The target of the reliability metric is going to be 7% percent. This target was generated as a benchmark from Apple's iPhone 7 which had a failure rate of %7. (cite). The iPhone 7 is a good standard for a system to follow.

Summary and Catalog:

After defining the functions, the logistical system was broadened to include an understanding of what it is the system has to do. The targets and metrics defined how these functions are to perform these tasks and outlined a path to completing them successfully. Metrics were assigned to each function and each metric was assigned a given target. Our main functions retrieve, process, store, and output were synthesized into three critical metrics: storage, reliability, and speed. The targets associated with these metrics are $0 < x <$ 10MB, the ratio of system successes to system failures 93%, and 2 min respectively.