Usability/Sentiment for the Enterprise and ENTERPRISE

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ABSTRACT

The purpose of the Sentiment of Search Study for NASA Johnson Space Center (JSC) is to gain insight into the intranet search environment. With an initial usability survey, the authors were able to determine a usability score based on the Systems Usability Scale (SUS). Created in 1986, the freely available, well cited, SUS is commonly used to determine user perceptions of a system (in this case the intranet search environment).

USABILITY/SENTIMENT FOR THE ENTERPRISE AND THE *ENTERPRISE*

The advanced nature of "search" has facilitated the movement from keyword match to the delivery of every conceivable information topic from career, commerce, entertainment, learning… the list is infinite. At NASA Johnson Space Center (JSC) the Search interface is an important means of knowledge transfer. By indexing multiple sources between directorates and organizations, the system's potential is culture changing in that through search, knowledge of the unique accomplishments in engineering and science can be seamlessly passed between generations.

This paper reports the findings of an initial survey, the first of a four part study to help determine user sentiment on the intranet, or local (JSC) enterprise search environment as well as the larger NASA enterprise. The survey is a means through which end users provide direction on the development and transfer of knowledge by way of the search experience. The ideal is to identify what is working and what needs to be improved from the users' vantage point by documenting:

- Where users are satisfied/dissatisfied.
- Perceived value of interface components.
- Gaps which cause disappointment in search experience.

The near term goal is it to inform JSC Search in order to improve users' ability to utilize existing services and infrastructure to perform tasks with a shortened life cycle. Continuing steps include an agency based focus with modified questions to accomplish a similar purpose.

LITERATURE REVIEW

SUS Use

According to the inventor of the System Usability Scale (SUS), John Brooke, it was originally a way to arrive at "some objective measures that would demonstrate the value of particular changes was fundamental to that justification in order to get UI changes included in a product release" (Brooke, 2013). Its intentional use is not diagnostic, but the determination of the problematic/agreeable system status. The SUS is a "tool to quickly and easily collect a user's subjective rating of a product's usability" (Brooke, 1996). It is ideal for collecting data because it does not have the same time, equipment, and personnel restraints as more traditional evaluations such click-through or eye tracking studies. By participating in the survey, users were able to quickly release their results while continuing to work and without interrupting the work of others, who are often required to serve as moderators for traditional studies. Additional characteristics of the SUS are its ease of use and administration, as well as its reliability and validity, regardless of sample size (Usability.gov, 2013).

SUS Construction

Although SUS was intended to be "quick and dirty" that refers only to its use; it was constructed with care. The ten questions selected were taken from a pool of 50 after careful evaluation and analysis. The questionnaire statements are scored on a 5-point scale ranging from "strongly agree" to "strongly disagree." The items constituting the final questionnaire were selected on the basis of several criteria:

- There had to be strong intercorrelations between all of the items selected.
- The total number of items had to be limited because of the constraints of time that we were working under when administering the questionnaire.

- Although usability for the usability survey was indeed a strong consideration, the survey originators chose questions which would require participants to think about their response before supplying the requested information.

The creators of the SUS selected 10 statements from the original pool; the intercorrelations between all 10 were in the range r=± 0.7 to ± 0.9. In addition, we selected statements so that the common response to five of them was strong agreement and to the other five, strong disagreement. (Brooke, 2013).

Validation

In their 2008 study, Bangor, Kortum & Miller reviewed SUS data collections from numerous projects and lifecycle stages spanning nearly a decade. Thanks to SUS versatility, modifications of the original questions set make it a viable tool.

In another work, measuring usability.com, it is reported that the SUS has become an industry usability standard for websites, mobile devices, software and hardware. At over 25 years old, the SUS is versatile, widely used and remains relevant despite technological advances (Sauro, 2011).

Scoring

The SUS uses 10 subjective questions and, most commonly, a 5 point Likert scale to gather in inputs used to arrive at the usability score (Usability.gov, 2013). Sauro's 2010 validity study of the SUS compared 5 and 7 point scales in consideration of response error. It was reported that due to the 10 question limit imposed by the SUS, the 7 point scale is beneficial because there was no "interpolating between choices." For example, when survey participants were unable to choose between 2 and 3 points on the 5 point Likert, the additional 2 points provided an extral level of granulation to more precisely reflect user sentiment. Sauro's work points to an additional SUS 7 point validation that found "Seven point Likert scales appear to be sensitive enough to record

a more accurate evaluation of the interface while remaining relatively compact" (Finstad, 2010).

Instruction for normalizing the 5 point Likert in relation to the SUS, is readily available from Usability.gov link to 'SUS-A Quick and Dirty Usability Scale (Brooke, 1986). For use at JSC, additional modifications, described below, were made to normalize the 7-point Likert.

Application

An additional application of the Bangor et al. (2008) research looked at the relationship between SUS scores and people's ratings of systems and products they were evaluating in terms of adjectives such as "good," "poor," or "excellent" and found that there was a close correlation. They propose that it is possible to take the SUS score for a particular product and give it a grading score. Using these guidelines, the grading scale was also used to provide additional comparison of the SUS scores provided by the JSC users.

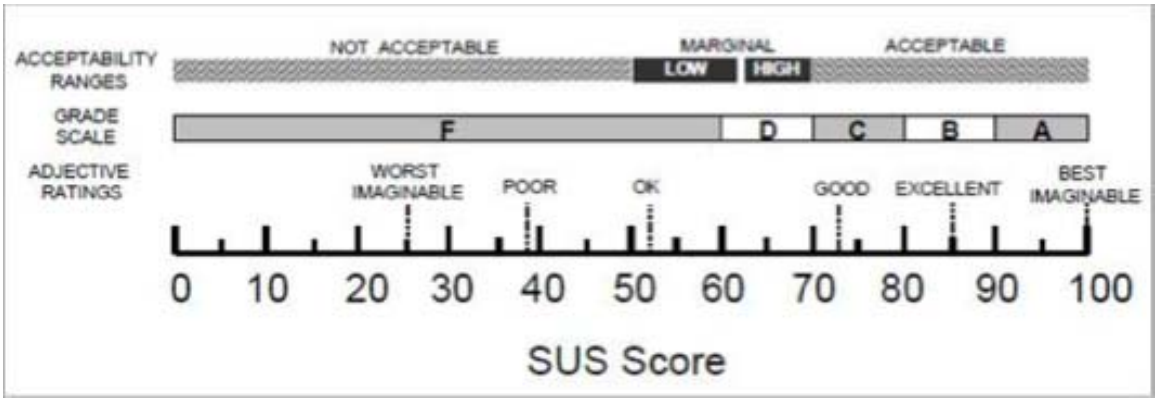


Figure 1. Grade rankings of SUS scores from "Determining What Individual SUS Scores Mean: Adding an Adjective Rating Scale," by A. Bangor, P.T. Kortum, and J.T. Miller, 2009, Journal of Usability Studies, 4(3), 114-123. Reprinted with permission

METHODOLOGY

At JSC, the Search Usability Scale (SUS) was used to determine the usability of the intranet search interface, from the user's perspective. A detailed description of the SUS can be found in the LITERATURE REVIEW section above.

Users were asked to voluntarily respond to the survey during the 3 week period of activity. Once the survey was closed, the responses were tabulated and scored based on the SUS methodology. Analysis of the scores is presented below.

Participants

The JSC Search interface is accessible to every employee via the Search page, as well as open text search boxes in registered web sites such as the JSC home page. It was appropriate to use a mechanism to reach out the broadest audience of information users. SUS survey distribution was primarily from the employee newsletter *JSC Today* and a link from the Knowledge Online site. The survey announcement described the SUS and its purpose and was distributed on three successive Mondays, coinciding with the activity period. The commonality of Centerwide infrastructure meant survey respondents were equally likely to come from the Mission Operations Directorate as the Information Resource Directorate.

A common goal of survey research is to collect data representative of a population, in this case users of the JSC Search. The research uses information gathered from a drawn sample back to the population, within the limits of acceptable error. However, when critiquing business education research, Wunsch state that "two of the most consistent flaws included (1) disregard for sampling error when determining the sample size, and (2) disregard for response and non-response bias (Kortlik, 2001).

To determine an acceptable amount, the Cochran sample size formula for continuous data was used. Cochran's formula:

$$n_0 = \frac{t^2 * s^2}{d^2}$$

- t = value for the selected alpha level in each tail
- s = estimate of the standard deviation in the population
- d = acceptable margin of error for mean being estimated

In this analysis, the alpha level, the level of risk the researcher is willing to take that the true margin of error may exceed the acceptable margin of error is .025 for each tail. Thereby t = 1.96.

The estimate for the standard deviation on the population for a 7 point scale is calculated by dividing 7 by 6, the number of standard deviations that include almost all of the possible values in the range. Based on this, s = 1.167.

The acceptable margin of error for the mean being estimated is calculated by taking the number of points on the primary scale (7) and multiplying by the acceptable margin of error (.04), the error researcher is willing to accept.

Based on this formula the minimum sample size is 67. Seventy one responses were received providing sufficient data to infer back to the population.

JSC SUS Modification

The first phase of the study to be distributed to participants is pictured below.

	Please mark the box most appropriate… if you have no opinion, just mark the middle box.	Strongly Agree.....N/A.....Strongly Disagree						
		1	2	3	4	5	6	7
1	I regularly use JSC Search (from the search box on the JSC Homepage or from the search page, https://google.jsc.nasa.gov							
2	I think JSC search is easy to use							
3	I think JSC search is difficult to use							
4	I use search to gather a broad scope of results related to a topic							
5	I use search to find a specific piece of data or application							
6	I enter multiple questions to find the results I need							
7	I generally find the results I need in the first few pages							
8	I use the feedback button or Ask-a-Librarian when I don't find what I need							
9	I expect JSC Search to work more like Google, with browsable sets of results							
10	I expect JSC Search to work more like Amazon.com, with personalization of results							
		Yes	No					
A	Are you familiar with JSC's advance search features?							
	If so, how often do you use advance search in an average week?	1-3	4-6	7-10	41591	14-17	18-20	>21
		Yes	No					
B	Are you familiar with secure search (vs public search)?							
	If so, how often do you use secure search in an average week?	1-3	4-6	7-10	41591	14-17	18-20	>21
C	What would make JSC Search ideal for you?							

Questions 1 -10 construct the SUS portion of the survey. As noted above they were developed to elicit strong negative of positive responses. Brooke alternates the items in order to avoid response biases, especially as the questionnaire invites rapid responses by being short; by alternating positive and negative statements, the goal was to have respondents read each statement and make an effort to think whether they agreed or disagreed with it. (Brooke, 2013).

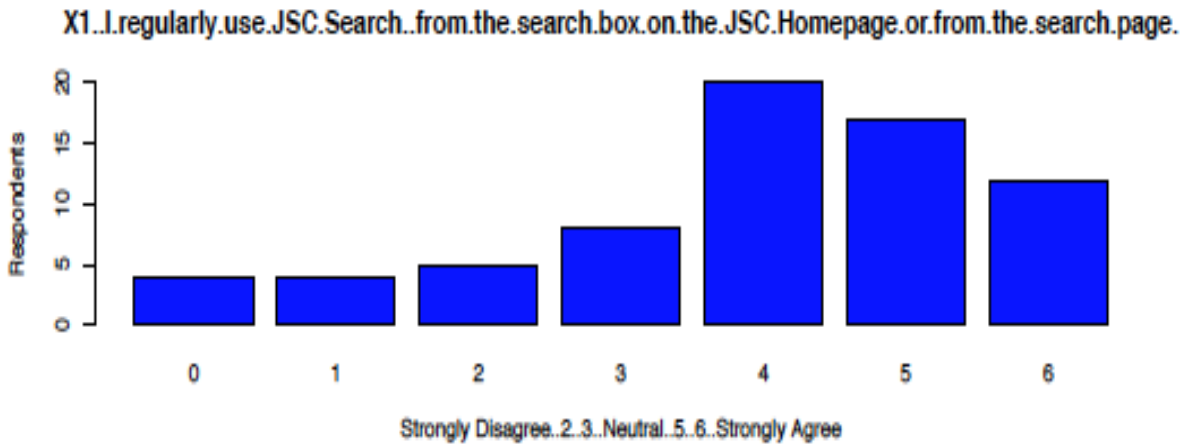
The final three questions are being used to gather information prior to proceeding into the next phase of the analysis, where we look at methods to improve search at JSC.

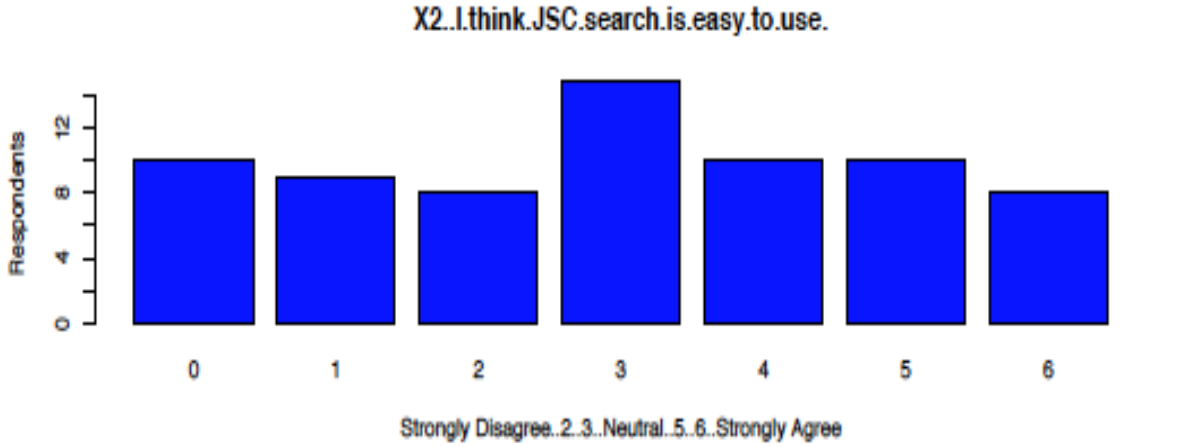
The survey was made available to all JSC employees on an internal SharePoint site. SharePoint's internal survey creation tool was used and the data was exported into a comma separated value (csv) file for analysis in R.

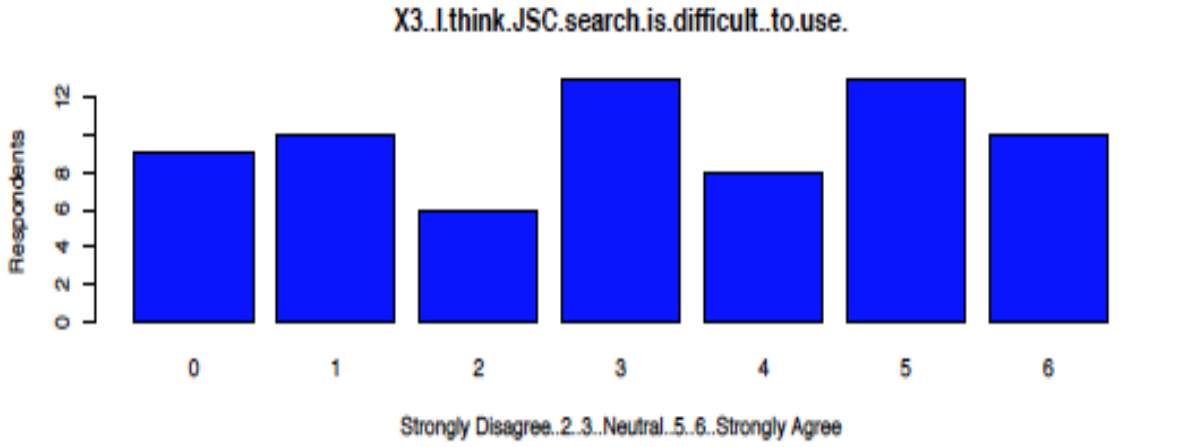
ANALYSIS

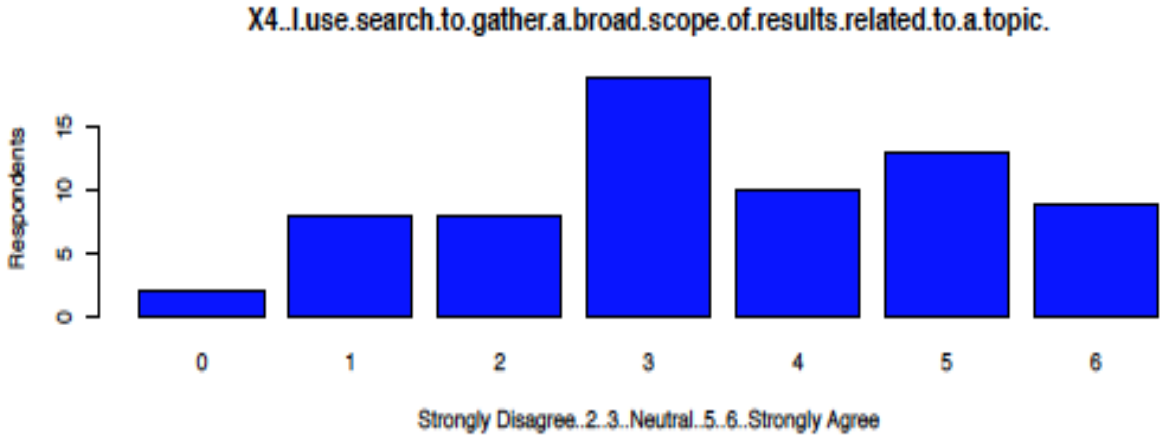
The raw scale scores submitted by the users (see Appendix) were used to calculate each individual users SUS score. The Total column in the spreadsheet holds the SUS score; it was calculated by totaling the sum of the positive question scale score – 1 and the difference of 7 minus the negative question scale score. The Score column contains the final SUS score after it has been normalized to the 100 point scale. The following histograms provide a visualization of the dispersion of the users' responses for each question.

Presentation of Data








X4..I.use.search.to.gather.a.broad.scope.of.results.related.to.a.topic.
Respondents
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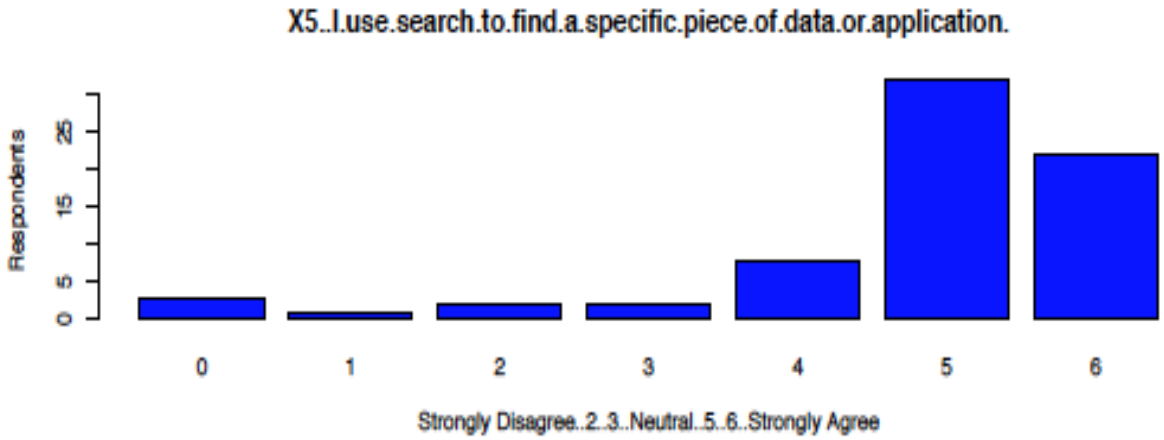
X5..I.use.search.to.find.a.specific.piece.of.data.or.application.
Respondents
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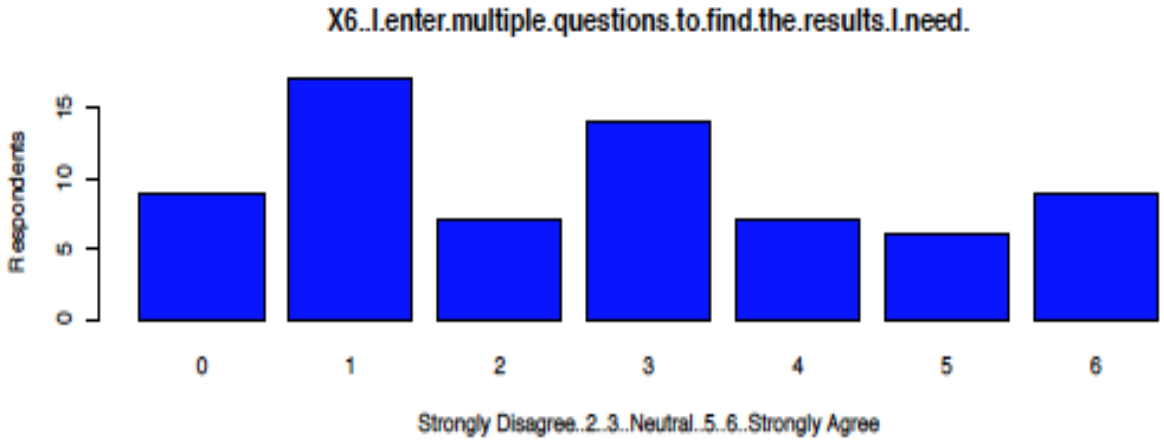
X6..I.enter.multiple.questions.to.find.the.results.I.need.
Respondents
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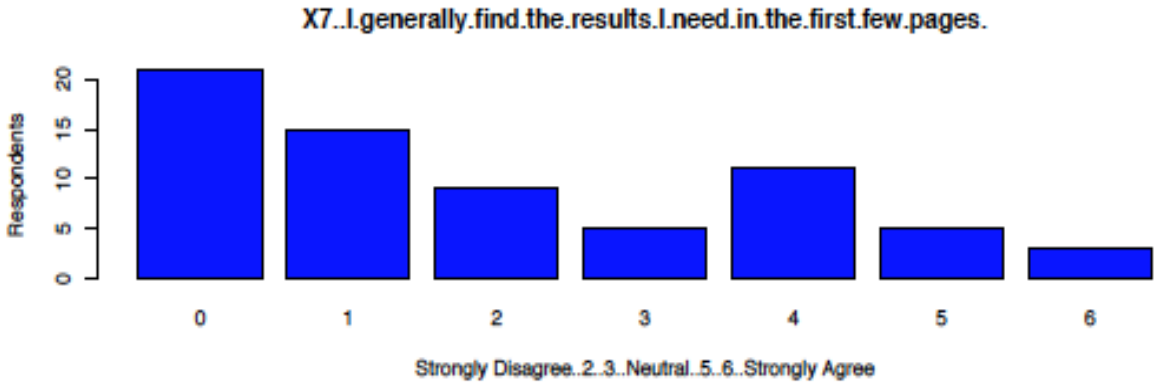
X7..I.generally.find.the.results.I.need.in.the.first.few.pages.
Respondents
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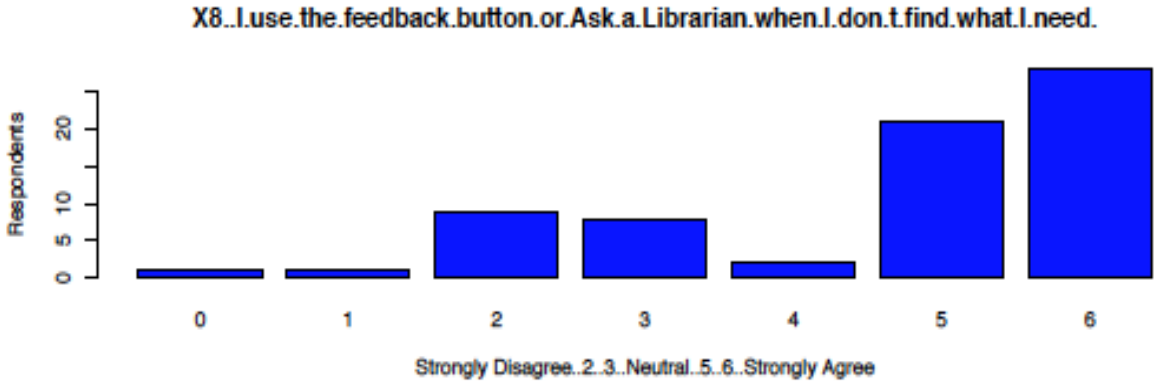
X8..I.use.the.feedback.button.or.Ask.a.Librarian.when.I.don.t.find.what.I.need.
Respondents
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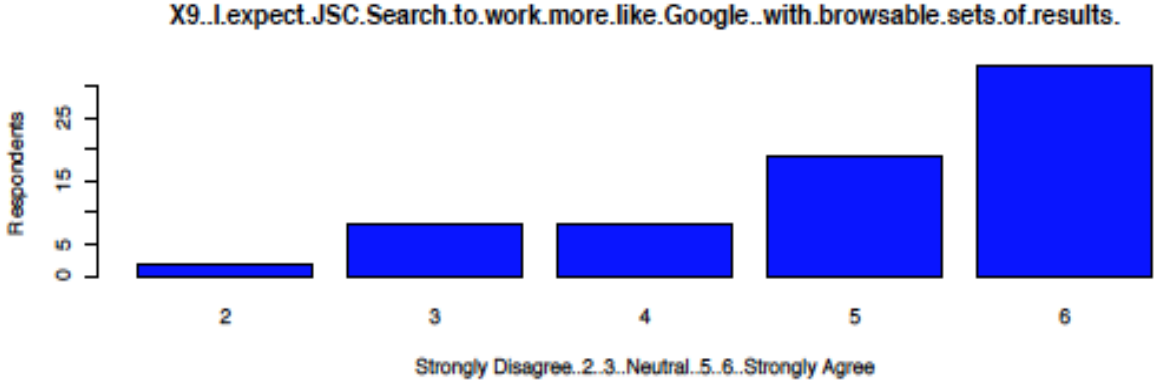
Strongly Disagree..2..3..Neutral..5..6..Strongly Agree


X9..I.expect.JSC.Search.to.work.more.like.Google..with.browsable.sets.of.results.
Respondents
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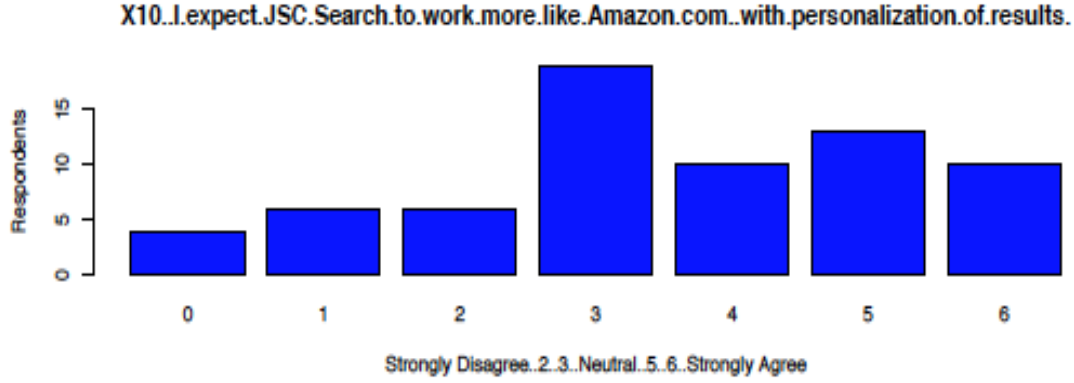
Strongly Disagree..2..3..Neutral..5..6..Strongly Agree


X10..I.expect.JSC.Search.to.work.more.like.Amazon.com..with.personalization.of.results.
Respondents
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Strongly Disagree..2..3..Neutral..5..6..Strongly Agree

SUS Score

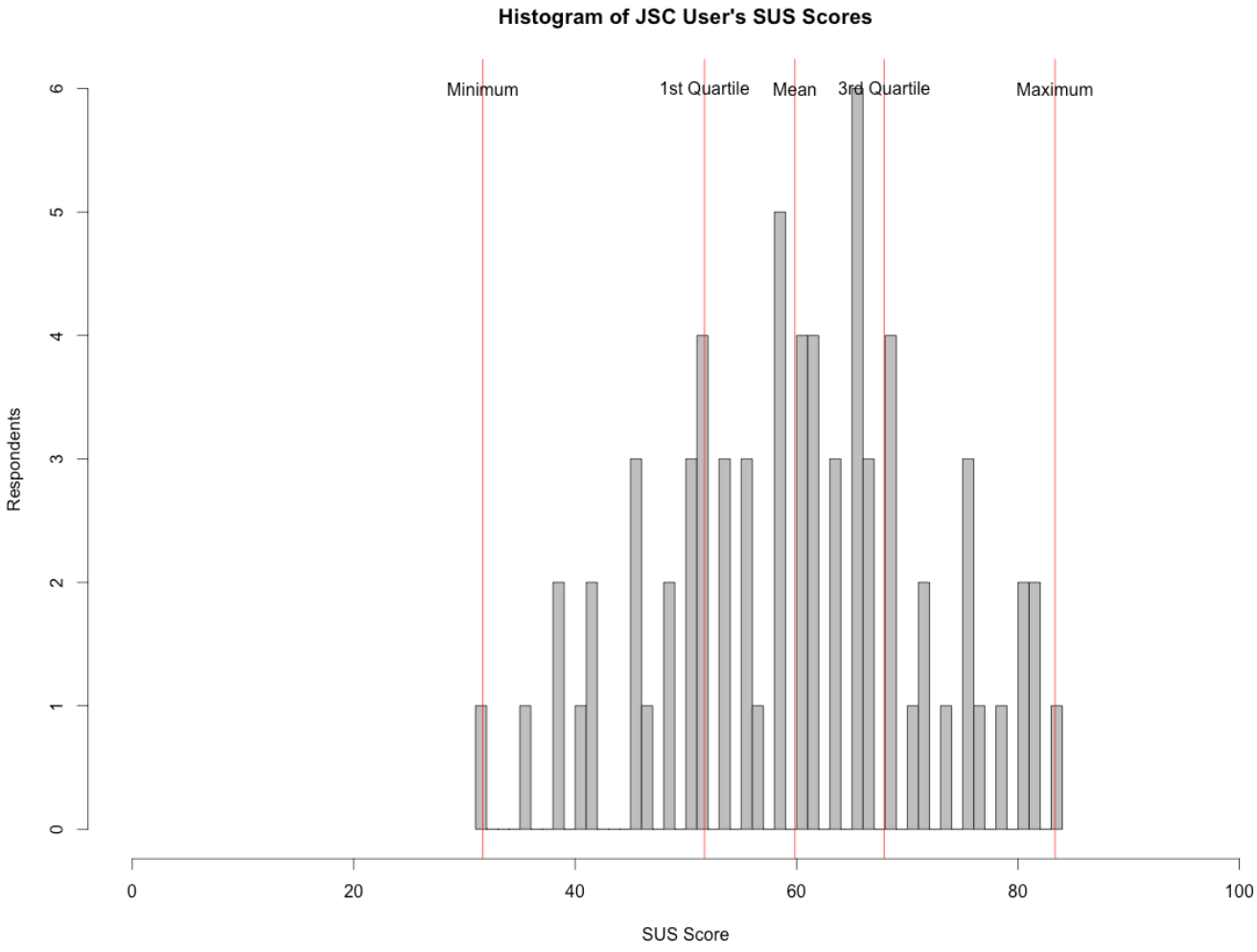
Since we are using a scoring system ranging from 0 to 100, researchers and readers often interpret SUS scores as percentages, which they are not. The normative data collected by Bangor, Kortum, and Miller (2008) and Sauro (2011) provided the basis for positioning SUS scores as percentiles, providing a more meaningful basis for interpreting SUS scores. Tullis and Stetson's (2004) research showed that using SUS enables you to get a measure of the perceived usability of a system with a small sample (say, 8-12 users) and be fairly confident that you've got a good assessment of how people see your system or product. With that in mind we will review the results from the JSC SUS survey.

In reviewing the summary statistics of the SUS scores, the scores fell into an approximate 50 point range with a maximum of 83.35 and a minimum of 31.67. This is a relatively small range that is not uncommon. Many people refrain from scoring something extremely high because of a belief there is always room for improvement. Conversely, people will not rate an item extremely poor if it provides some perceived value. Fifty percent of the scores were within 51.68 and 67.93 with the median score being 61.01, again a tight range. We interpret this to suggest half of the users have a fairly common perception of the system usability. However, as demonstrated by the summary statistics, 75% of the users scored the system at 67.93 or lower, a score that indicates a level of dissatisfaction from three-fourths of the population.

How can the results best be interpreted? While a 100-point scale is intuitive in many respects and allows for relative judgments, information describing how the numeric score translates into an absolute judgment of usability is not known. Using Bangor's, et al. research the SUS scores were overlaid an adjective rating and grade scale to add clarity. The following sections describe the results.

Minimum	31.67
1st Quartile	51.68
Median	60.01
Mean	59.85
3rd Quartile	67.93
Maximum	83.35
Standard Deviation	12.10

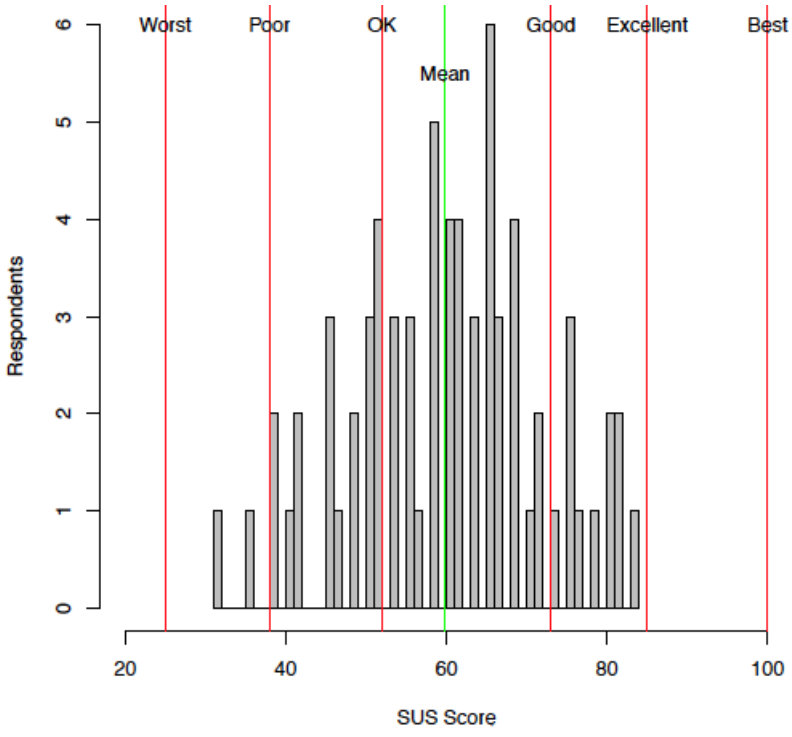
Table 1: JSC Usability Results



A study was conducted by Bangor et al to determine if an adjective description scale would be useful in providing a more intuitive depiction of the respondent's usability perception. A correlational analysis was conducted to determine how well the ratings (using the adjective rating scale) matched the corresponding SUS scores given by participants (i.e., via their ten individual ratings). Results were highly significant ($\alpha<0.01$) with $r=0.822$. The findings suggest the use of an adjective scale would be helpful in providing a subjective label to the SUS score, one users would be able to decipher quickly.

The histogram of the respondents SUS score is displayed again below, this time, the adjective description scale is overlaid. The figure clearly shows most, 75%, of the responses were below "Good". On the positive side, 67% of this total fell between "Ok" and "Good", with the reminder, 33%, below "Ok".

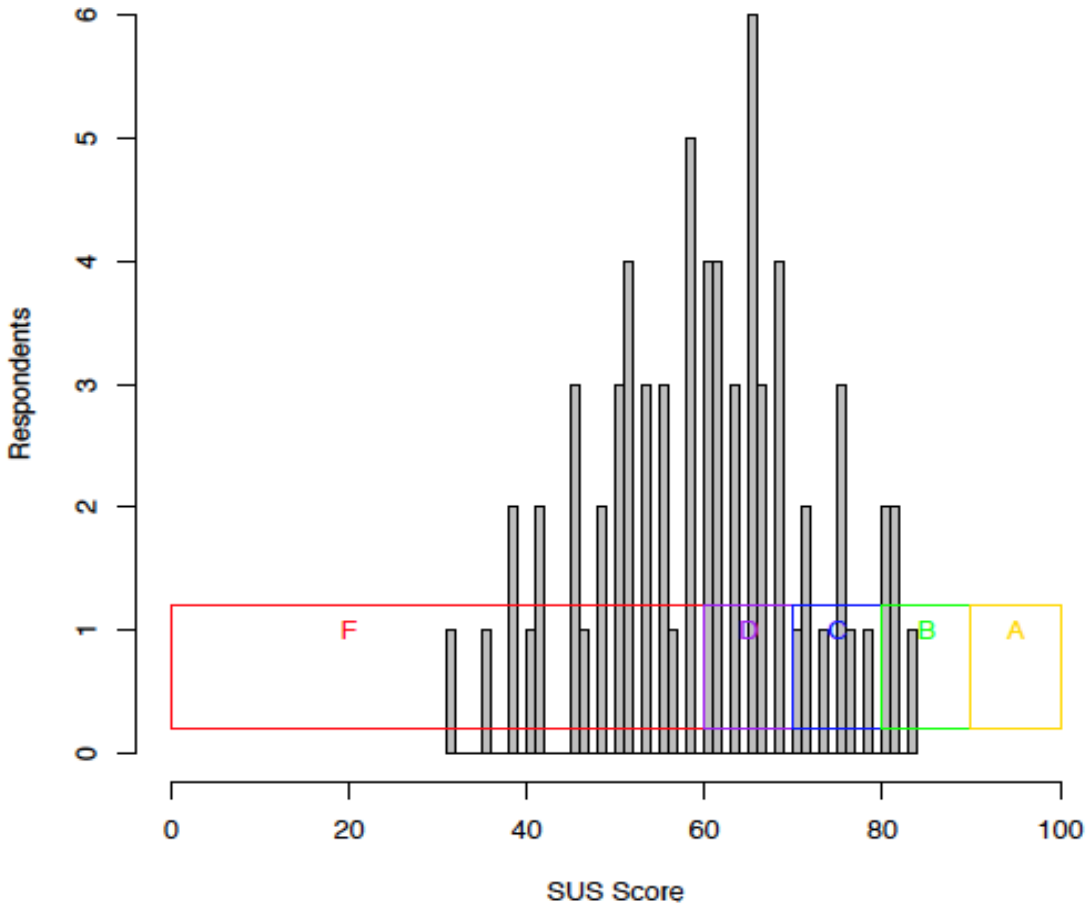
Histogram of JSC User's SUS Scores: Adjective Scale



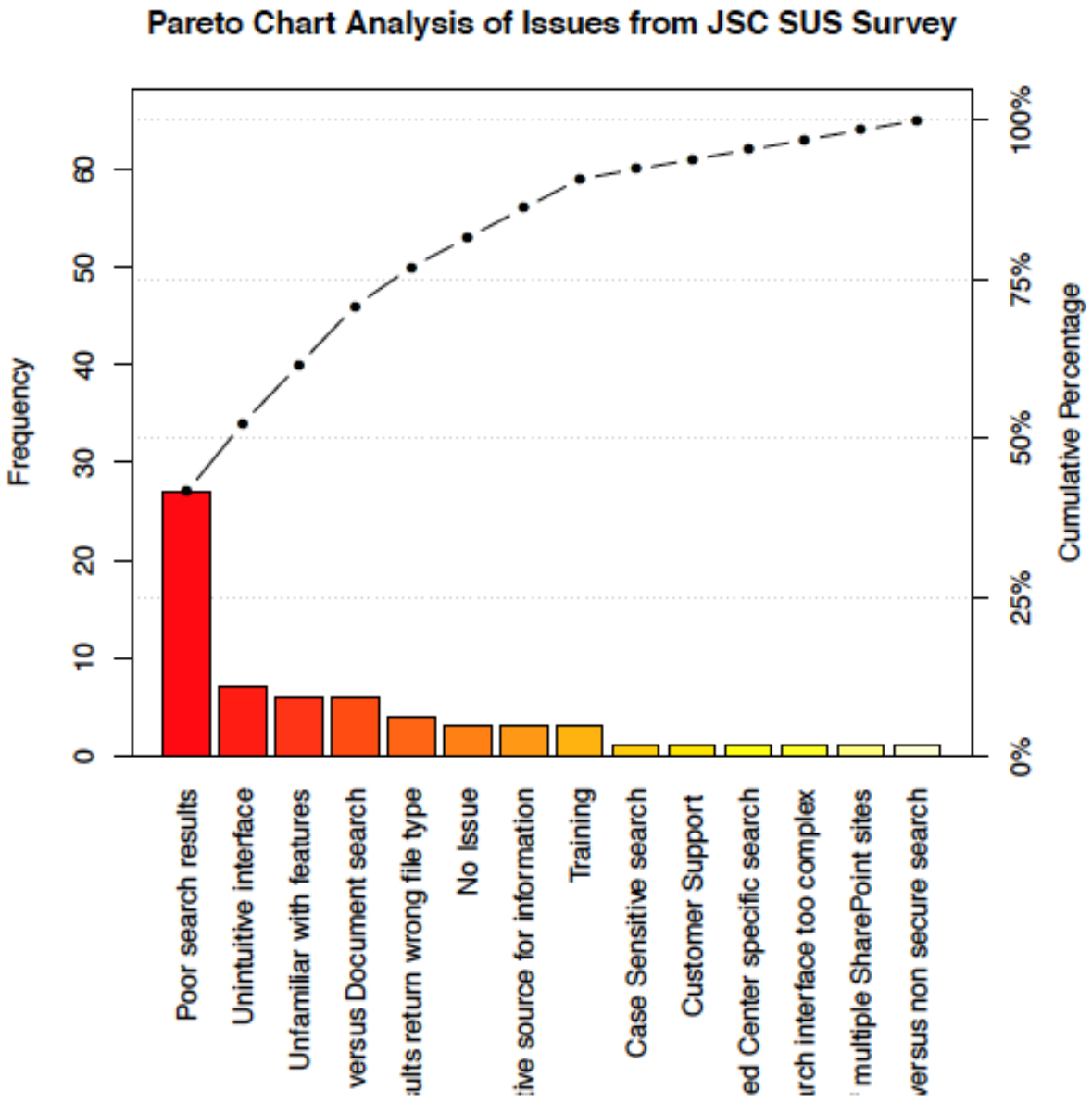
Grade Rating

Over the course of the 10 year study reported by Bangor, Kortum, and Miller an anecdotal pattern in the test scores had begun to emerge that equated quite well with letter grades given at most major universities. The concept of applying a letter grade to the usability of the product was appealing because it is familiar to most of the people who work on design teams regardless of their discipline. Having an easy-to-understand, familiar reference point that can be easily understood by engineers and project managers facilitates the communication of the results of testing. Like the standard letter grade scale, products that scored in the 90s were exceptional, products that scored in the 80s were good, and products that scored in the 70s were acceptable. Anything below a 70 had usability issues that were cause for concern.

Histogram of JSC User's SUS Scores: Grade Scale



Categories of Issues Identified by JSC Users



DISCUSSION

As with any improvement initiative, one must first examine and document the current reality of the situation. In this scenario, a method was needed to determine the usability of a search interface in addition to the user's perception on how well the search system was providing results. The use of the SUS provided a mechanism to quickly ascertain information in both areas, by adding one additional open-ended question at the end. The first ten questions allowed us to examine the usability of the system, while the last questions informed us on how the users rated the performance of the search results. The final analysis provides us with a better understanding of the current situation and areas to focus on for improvement.

The power of search applications to enhance knowledge transfer is indisputable. The performance impact for any user unable to find needed information undermines project lifecycle, resource and scheduling requirements. Ever-increasing complexity of content and the user interface make usability considerations for the intranet, especially for search, a necessity instead of a 'nice-to-have'. Despite these arguments, intranet usability is largely disregarded due to lack of attention beyond the functionality of the infrastructure (White, 2013).

The data collected from users of the JSC search system revealed their overall sentiment by means of the widely-known System Usability Scale. Results of the scores suggest 75%, ±0.04, of the population rank the search system below average. In terms of a grading scaled, this equated to D or lower. It is obvious JSC users are not satisfied with the current situation, however they are eager to provide information and assistance in improving the search system. A majority of the respondents provided feedback on the issues most troubling them. This information will be used to enrich the next phase, root cause analysis and solution creation.

Future Work

Understanding the existence of a challenge is the first step in defining a long term solution. The information collected in this survey provides the base line report to develop a

course of action. Based on the survey results, the quality of search results, in conjunction with the interface ease-of-use are the two user-defined areas for improvement. In the next phase of the study, the Knowledge Management Office in collaboration with the Information Resources Directorate will research users' tendencies and requirements as they pertain to search habits. The ultimate goal is to design and implement a search environment based on discovery needs. Future research to explore, define, and deliver the most relevant data in a format responsive to user queries is highly recommended.

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APPENDIX

The table above depicts the raw scores submitted by the users. The Total column is the raw SUS score, calculated by summing of the positive question scale score – 1 and 7 minus the negative question scale score. The Score column is the final SUS score after it has been normalized to the 100 point scale.

1. I regularly use JSC Search (from the search box on the JSC Home page or from the	2. I think JSC search is easy to use.	3. I think JSC search is difficult to use.	4. I use search to gather a broad scope of results related to a topic.	5. I use search to find a specific piece of data or application.	6. I enter multiple questions to find the results I need.	7. I generally find the results I need in the first few pages.	8. I use the feedback button or Ask-a-Librarian when I don't find what I need.	9. I expect JSC Search to work more like Google, with browsable sets of results.	10. I expect JSC Search to work more like Amazon.com, with personalization of results.	Total	Score
6	3	4	3	6	6	3	5	6	4	32	53.34
6	6	1	6	6	4	7	1	6	1	48	80.02
5	6	2	2	7	2	6	1	7	4	50	83.35
4	7	1	4	5	2	6	1	5	3	46	76.68
5	1	6	3	7	6	2	2	7	4	31	51.68
5	2	6	3	7	4	1	5	6	4	29	48.34
5	4	5	6	6	6	4	5	6	6	27	45.01
5	4	4	4	6	6	5	3	6	4	35	58.35
4	3	5	1	7	2	3	4	6	2	39	65.01
3	1	7	3	5	3	2	1	4	4	27	45.01
6	3	6	4	7	1	2	1	7	3	40	66.68
6	6	2	5	6	2	5	1	4	4	43	71.68
3	5	2	1	7	3	2	5	4	2	38	63.35
6	2	6	4	6	1	2	2	7	7	33	55.01
7	7	2	4	6	6	1	1	6	3	41	68.35
6	1	7	1	7	7	1	1	7	5	31	51.68
5	4	4	6	6	1	3	1	7	1	42	70.01
4	4	4	4	7	6	4	1	7	1	40	66.68
1	1	7	1	1	1	1	4	7	7	21	35.01
2	4	4		6		1	1	6		44	73.35
1	1	6	2	2	7	1	4	7	4	19	31.67
6	3	5	4	7	2	2	2	6	6	35	58.35
7	5	2	2	3	4	1	5	5	4	34	56.68
1	7	1	1	1	7	1	1	7	1	36	60.01
5	2	4	4	6	4	1	2	6	5	31	51.68
6	3	6	6	6	4	3	4	7	3	32	53.34
7	4	4	1	7	7	1	2	7	1	41	68.35
7	3	5	4	6	1	5	2	4	4	39	65.01
2	3	5	2	6	3	1	5	7	6	28	46.68
5	4	4	2	6	2	5	2	6	2	44	73.35
1	2	7	1	1	1	2	2	7		32	53.34
2	2	6	4	6	6	2	1	4	6	23	38.34
6	4	4	5	6	7	2	1	3	5	29	48.34
3	6	2	3	5	4	5	2	6	3	41	68.35
7	6	3	3	7	7	1	7	3	4	30	50.01
4	4	2	4	6	6	5	2	6	2	39	65.01
4	5	3	5	6	5	5	4	5	3	35	58.35
6	6	3	5	5	5	6	3	4	3	38	63.35
6	7	1	4	5	3	4	1	6	4	45	75.02
6	4	5	3	6	6	2	1	7	4	36	60.01
7	1	7	1	7	4	1	1	7	2	38	63.35
5	2	6	2	6	3	1	2	6	2	35	58.35
2	5		6	6	6	3	2	7	7	32	53.34
5	6	2	2	6	4	3	1	7	1	47	78.35
5	4	4	5	6	4	3	2	5	5	33	55.01
3	1	7	2	6	5	1	1	5	1	30	50.01
6	6	1	4	7	4	6	1	4	4	45	75.02
4	4	4	5	6	6	5	2	6	2	36	60.01
6	6	1	4	5	1	1	5	7	7	37	61.68
6	5	2	6	3	6	4	6	5	2	31	51.68
5	5	3	2	7	1	7	4	7	3	48	80.02
6	4	4	6	6	3	2	2	5	6	32	53.34
5	2	2	2	5	5	2	2	6	2	37	61.68
7	7	2	7	7	5		1	7	1	42	70.01
5	4	4	2	7	5	3	5	7	3	37	61.68
5	2	6	4	7	3	4	2	7	1	39	65.01
7	1	7	1	7	1	1	1	6	2	40	66.68
5	6	2	4	6	6	1	1	7	3	39	65.01
7	7	1	3	7	4	5	2	7	4	49	81.68
5	5	3	3	5	6	1	1	7	4	36	60.01
5	1	7	3	7	6	2	5	7	4	27	45.01
4	1	7	4	4	4	1	4	7	4	24	40.01
6	5	3	5	7	6	1	2	7	5	35	58.35
5	5	3	5	6	7	3	2	7	2	37	61.68
7	5	2	7	6	7	5	1	7	2	41	68.35
4	2	6	2	6	5	2	4	7	4	30	50.01
7	7	1	6	7	4	6	1	6	2	49	81.68
5	7	1	2	6	7	2	1	7	1	45	75.02
3	3	3	4	6	6	5	1	5	5	33	55.01
7	4	1	4	4	4	7	2	4	6	39	65.01