PERVASIVE TECHNOLOGY INSTITUTE

TECHNICAL REPORT

# XSEDE Return on Investment (Proxy) Data and Analysis Methods, July 2014 to August 2019

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# 1 Executive Summary

In an effort to develop an understanding of return on investment (ROI) for National Science Foundation (NSF) funding provided to the eXtreme Science and Engineering Discovery Environment (XSEDE) supercomputing support ecosystem, a longitudinal study based on annual surveys was started in 2014. This report outlines the results of the study through August 30, 2019.

wROI is understood to be the ratio of value generated from an activity to value of assets used to perform that activity. When this ratio is greater than 1, the net return is more than the value of assets used and is therefore a profitable activity. XSEDE is not a commercial enterprise so defining and measuring investment and return on its activities requires some thought. As applied to investments in cyberinfrastructure, "value" may be defined in many ways. On the investment side, value can be measured as the funding put into providing services to be consumed. On the return side, the picture is less clear but is conceptually related to output measures such as productivity of the user community, efficiency represented by user uptake of shared services, efficiency in conducting research, user satisfaction, and cost avoidance of users inefficiently expending their own funds to provision and consume similar resources. We define these parallel but alternative measures for investment and return as *proxies* for actual ones, and the ROI as an *ROI proxy* or typographically as $ROI_{proxy}$.

The overall approach taken was to define stakeholder groups of users based on the services they consumed, identify costs associated with the production of those services, and establish a basis for valuing the actual consumption of those services versus an alternative. For instance, an investigator may consume a specific amount of training expressed as hours. The cost for offering this training can be expressed as the total cost for the service divided by the total units of service (hours) delivered. Costing for a hypothetical alternative for which investigators could pay themselves instead of using the XSEDE service can be established using commercial benchmarks. Data related to this study are available at *https://doi.org/10.5967/6tc4-sb46*.

The overall annual *return on investment proxy* ratios for XSEDE as determined by the methodology described in this report are shown in the table below. The $ROI_{proxy}$ for Program Years 4 through 8 have steadily increased year over year, from 1.11 to 1.77, and their average for the program is 1.46. In other words, for the five years studied, for every $1 the NSF invested in XSEDE, $1.46 in value was generated.

**XSEDE Return on Investment (Project Years 4-8)**

| Category of Value (Proxy for return) | PY4 Jul14-Jun15 | PY5 Jul15-Aug16 | PY6 Sep16-Aug17 | PY7 Sep17-Aug18 | PY8 Sep18-Aug19 | Combined PY4-PY8 |
|---|---|---|---|---|---|---|
| **XSEDE Total Value by Proxy Measures** | $26,246,780 | $30,868,122 | $25,277,155 | $34,561,675 | $35,373,153 | **$152,326,885** |
| **XSEDE Total Expenditure** | $23,562,931 | $23,067,000 | $18,285,622 | $19,561,588 | $19,993,698 | **$104,470,839** |
| **XSEDE Total $ROI_{proxy}$** | 1.11 | 1.34 | 1.38 | 1.77 | 1.77 | **1.46** |

## 2 Introduction

The Extreme Science and Engineering Discovery Environment (XSEDE) is an NSF-funded virtual organization that integrates and coordinates the use of advanced digital services - including supercomputers and high-end visualization and data analysis resources – by the US open (unclassified) research community [11]. XSEDE coordinates the use of hundreds of millions of dollars' worth of supercomputers funded by the US Federal Government. That takes a lot of effort. XSEDE itself is thus also a fairly expensive project with a budget somewhat in excess of $20M per year.

In part because of the project's large budget, a representative of the National Science Foundation approached XSEDE and not at all unreasonably requested that we consider looking into analysis and documentation of the Return On Investment (ROI) for the US National Science Foundation's investment in XSEDE. This was a perfectly reasonable request, and ROI has a perfectly straightforward definition. A textbook definition explains ROI as "A ratio that relates income generated . . . to the resources (or asset base) used to produce that income" [12]. The challenge in much government-funded research - particularly that which takes place at colleges or universities - is that there is generally no income generated in the short run as a result of such research. This doesn't mean there is not a payoff in the end. Quantum physics is a good example. Quantum physics theory and research in the 1920s through 1940s had little effect on civil life within the US in the first years after the major discoveries of this then new field (military applications being another matter). However, quantum physics eventually played an incredible role in many areas of everyday life including storage technology used in personal computers. The total annual economic value created in storage technology by application of quantum physics research reached a high point of $24B in 2017. In the long run, research can pay off handsomely.

In the short run however a project like XSEDE simply does not sell anything and does not generate as a rule any immediate impact beyond the jobs created directly by expenditure of grant income. So when we look at a formula, based on the definition above, such as:

$$\text{ROI} = \frac{\text{Income received from sale or paid-for use of product}}{\text{Cost to generate product}}$$

Then there are only two possible answers for a project like XSEDE: 1) The ROI is zero since there is no income to the Federal Government; 2) The concept of ROI makes no sense as applied to an entity like XSEDE. Neither answer is at all satisfactory, particularly when most everyone immediately gets an intuitive understanding of what is meant by a concept like ROI.

Stewart et al. [1] discussed the concept of the value returned for investment in CI services through the lens of a logic model-based view of program evaluation [13], from which Figure 2-1 below is adapted.

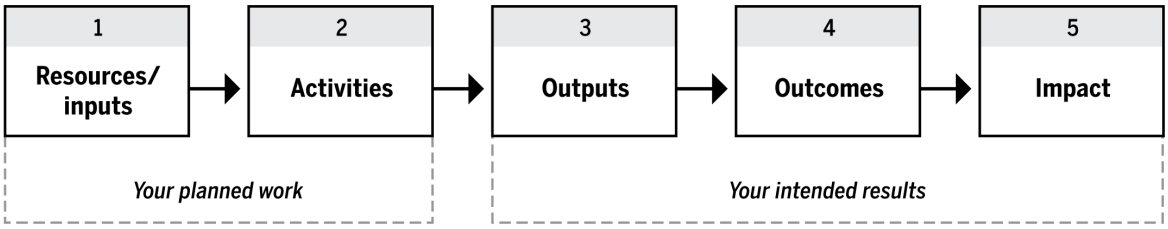


Figure 2-1. Logic Model of Organizational Processes

Looking at this we can see that when it can take years of research and development work to bring a new concept into practical use in everyday life in the US (outcomes and impact), it's just not possible to measure ROI in a traditional sense.

What we *can* do is measure the financial effectiveness of the way we conduct our activities. Stewart et al. [1] defined $ROI_{proxy}$ as

$$ROI_{proxy} = \frac{\text{Cost of doing something in some reasonable way other than what was done}}{\text{Cost of doing that thing in the way that was actually done}}$$

A key point in use of this approach is that the "Cost of doing something in some reasonable way other than what was done" is intended to be either a reasonable market cost or the best possible market cost. One could argue that $ROI_{proxy}$ as we have defined it is simply cost avoidance expressed as a ratio. Kinney and Raiborn [12] in fact define cost avoidance as "the cost difference between, or ratio of, doing something one way versus another other way). However, cost avoidance has in general a bit of a bad reputation as a metric because cost avoidance figures tend to be fantastical – a value based on a completely ridiculous way to do something that one would in fact never do in practice.

Perhaps most importantly, the term $ROI_{proxy}$ retains the intuitive and valuable sense of ROI while being defined in a way that is analogous to but not contradictory with the proper accounting definition of ROI. Like ROI, a value for $ROI_{proxy}$ greater than 1.0 means that one is getting more for one's money than one would at standard market rates.

And while one hopes and expects that over the course of many years and decades, the ROI on scientific research and the computing facilities that enable scientific research, in terms of income say to the US economy divided by the federal investment in research that enables such income, is very high. $ROI_{proxy}$ is a measure of the *effectiveness of means*, *not the value of ends*, but it is something that can be analyzed on an annual basis to provide a sense of the fiscal and operational effectiveness of the means.

This technical report on assessment and analysis of $ROI_{proxy}$ for National Science Foundation (NSF) funding provided to the XSEDE (eXtreme Science and Engineering Discovery Environment) supercomputing support ecosystem and describes assessment methodologies and data collected over the last five years (7/1/2014-8/30/2019.) The appendices of this document and an associated dataset [14] contain the data collected and analyses performed.

The primary purpose of this longitudinal study is to determine the financial effectiveness of NSF investments in XSEDE. Over the period of the study, both the scope and detail of information about services provided have been extended, leading to better models for understanding the value provided to the U.S. research community. New data included in this report covers the XSEDE Cyberinfrastructure Resource Integration (CRI) services [9] providing software repositories and on-campus support engagements. For a detailed explanation of cyberinfrastructure see reference [15].

As applied to investments in cyberinfrastructure, "value" may be defined in many ways. On the investment side, value can be measured as the funding put into providing services to be consumed. On the return side, the picture is less clear, but is conceptually related to output measures such as productivity of the user community, efficiency represented by user uptake of shared services, efficiency in conducting research, user satisfaction, and cost avoidance of users inefficiently expending their own funds to provision and consume similar resources.

The overall approach we took was to define stakeholder groups based on the services they consumed, identify costs associated with the production of those services, and establish a basis for valuing the actual consumption of those services versus an alternative. For instance, an investigator may consume a specific amount of training expressed as hours. The cost for offering this training can be expressed as the total cost for the service divided by the total units of service (hours) delivered. Costing for a hypothetical alternative for which investigators could buy themselves instead of using the XSEDE service can be established using commercial benchmarks. For the purposes of this study benchmark costs are at a single point in time. Additional details on analysis of this data and discussion of alternative approaches over the lifetime of this study can be found in references [2] and [3].

The study's instruments ask respondents to provide fundamental measures of consumption, such as hours of service consumed or delivered. These measures are independent of a broad range of approaches for valuation, so the longitudinal utility of the study data is preserved even when some assumptions in valuation computations may need to be changed in the future, or different valuation models applied.

In this study the components of $ROI_{proxy}$ are defined as: (1) *Investments* or costs related to funding XSEDE paid for by the US Federal Government through grant awards through the National Science Foundation to the University of Illinois Urbana-Champaign and its collaborators in operating XSEDE; and (2) *returns* or value of services as measured by usage multiplied by a cost proxy.

We also note that the $ROI_{proxy}$ for XSEDE is for the services offered by XSEDE to allocate, manage accounts and security for, support, and provide training for a suite of advanced cyberinfrastructure systems funded through separate grant awards by the National Science Foundation. A list of the "Level 1 Service Provider Resources" – those systems that are required by NSF policy to be allocated through and have usage monitored through XSEDE – is shown in Table 2-1.

Table 2-1. Level 1 SP resources in existence or funded as of 7/1/2020.

| Resource | Service Provider |
|---|---|
| Stampede | Univ of Texas at Austin |
| Comet | San Diego Supercomputer Center |
| Wrangler | Texas Advanced Computing Center |
| Jetstream | Indiana University |
| Bridges | Pittsburgh Supercomputing Center (PSC) |

As a general note, the methodology for data collection in this study has matured and become more complete year by year. Some of this is refinement in methodological approaches (e.g. better designed survey instruments year to year). Also, as the project has evolved we have been able to expand the areas of "return" we measure as the project has gone on.

Table 2-2 contains the time periods covered by this study and the meaning of "Program Year" (PY). Program Years are the management and fiscal time units used by the National Science Foundation to manage the project.

Table 2-2. Calendar Dates for Program Years 4 through 8

| Program Year (PY) | Calendar Dates |
|---|---|
| 4 | 7/1/2014 - 6/30/2015 |
| 5 | 7/1/2015 - 8/30/2016 |
| 6 | 9/1/2016 – 8/31/2017 |

| | |
|---|---|
| 7 | 9/1/2017 - 8/30/2018 |
| 8 | 9/1/2018 - 8/30/2019 |

## 3 Methodology

In order to measure investment and return related to XSEDE services, a series of survey instruments were designed to collect relevant investment and return measures and issued to provider and user stakeholders annually 2014-2019. These are described below.

*A. Stakeholders* - The following stakeholder groups were identified and included in the sampling population:

- Level 1 and Level 2 Service Providers – Institutions that are funded by the NSF to provide XSEDE allocated services
- Level 3 Service Providers – Institutions that are members of the XSEDE Service Provider Forum, but do not provide services that are allocated by XSEDE mechanisms
- End-user Investigators who used Extended Consulting Support Services (ECSS) to develop specific research solutions using XSEDE facilities
- End-users who used XSEDE training resources
- End-users and institutional representatives who used XSEDE XCI/Campus Bridging software repository resources
- Campus research cyberinfrastructure providers who used XCI/Campus Bridging on-campus technical consulting services
- End-users who submitted tickets to the XSEDE Helpdesk

Although the XSEDE Program Office (PO) was not included in a data collection protocol approved for this study, financial data about expenses for various groups within XSEDE needed for the $ROI_{proxy}$ evaluation was provided by the PO. We therefore consider the PO to be a stakeholder in the study.

Note that all Service Providers represent independent organizations and provide value to XSEDE as well as receive value from it. In this study we use the value that XSEDE is *perceived to provide* to a Service Provider as

a measure of return. The value is expressed in terms of FTEs the SP did NOT have to hire to provide a given activity multiplied by the average cost to XSEDE for that FTE. While this may not be a perfect measure, it seemed to us to be the best option among those we could conceive. Asking the recipients of a service what the service is worth is – on the face of it – a seemingly rational and reasonable thing to do.

*B. Investment measures* used in this study are the actual budget expenditures for the following XSEDE activities in total and per FTE funded for those activities. Table 4-1 below provides these measures.

*C. Return measures per stakeholder group* were selected as follows:

1. Service Providers (SPs)[1]
    a. Level 1 Service Providers "meet all XSEDE integration requirements and will explicitly share digital services with the broader community of researchers supported by the XSEDE environment and infrastructure, with access to those digital services made available through the XSEDE allocation process."
    b. Level 2 Service Providers "make one or more digital services accessible via XSEDE services and interfaces, share one or more digital services with the XSEDE community along with the organization's local users, and meet a subset of the requirements for Level 1 Providers."
    c. Level 3 Service Providers "are the most loosely coupled within the XSEDE Federation; they will advertise the characteristics of one or more digital services via XSEDE mechanisms, might make those resources or services accessible via XSEDE compatible interfaces but need not make digital services available "locally" via XSEDE services or interfaces, and are not required to share services with the XSEDE user community."
2. Investigators with XSEDE allocations and end-users
    a. Value of in-person training - This is a measure of cost avoidance by users. Since XSEDE training is free, the cost of an equivalent commercial service was used as a proxy and estimate for the value generated by XSEDE training activities. Total hours of training delivered (session length in

[1] See for detailed SP type definitions: https://www.xsede.org/documents/10157/281380/SPF_Definition_v10.2_130716.pdf

hours x number of participants) x $11.29 per hour (cost for training for a reference service)

b. Value of on-line training provided – As with in-person training, this is a measure of cost avoidance by users. The cost of an equivalent commercial service was used as a proxy and estimate for the value generated by delivered XSEDE training hours. Total hours of training consumed x $9.98 per hour (cost for on-demand basic web development class from a commercial vendor.)

3. Investigators using ECSS services
    a. Number of person-months that they estimate they saved as a result of use of ECSS services multiplied by the average per month cost of XSEDE ECSS staff.
4. End-users and institutional representatives who used XSEDE XCI/Campus Bridging software repository resources.
5. Campus research cyberinfrastructure providers who used XCI/Campus Bridging on-campus technical consulting services.

Table 3-1 summarizes the stakeholder groups, input measures and output measures defined in this study.

Table 3-1. Summary of stakeholders and valuation proxy measures

| Stakeholder group | Services evaluated | Role of measure (investment or return) | Measures used for valuation |
|---|---|---|---|
| XSEDE Program Office | XSEDE Services | Investment | FTE cost for XSEDE staff |
| Service Providers | Services provided by XSEDE to SPs | Return | Surveyed SPs to determine how many person-months SP representatives believe XSEDE services provided to them; calculate value based on actual average cost per relevant group of XSEDE staff |
| Investigators | In-person training about XSEDE resources | Return | Total hours of training delivered (session length x participants) x $11.29 per hour (cost for training from Fred Pryor on use of spreadsheet software [2] |
| Investigators | Online training about XSEDE resources | Return | Total hours consumed x $9.98 per hour (cost for on-demand basic web development class from hrclassroom.com [4] |

| | | | |
|---|---|---|---|
| Investigators | ECSS services: Consulting and programming | Return | Surveyed PIs to determine the number of person-months that they estimate they saved as a result of use of ECSS services; costed at the compensation per month of a Computer and Information Research Scientist |
| Campus research CI providers | Value of Campus Bridging software repository resources | Return | Counted downloads of ready-to-install software packages, valued at 30m compensation for a Network and Computer Systems Administrator |
| Campus research CI providers | Value of Campus Bridging on-campus technical services | Return | Surveyed campus research CI providers who have used XSEDE CRI Campus Bridging on-campus technical services about the effort in person-days each engagement saved them, what savings they experienced in hardware and software purchases, and recurring hardware/software cost and time savings experienced in years following an engagement. |

### *3.1 Instruments for surveying Service Providers*

XSEDE Service Providers (SP) fall in to three groups: Level 1 (5 sites), facilities located at primary supercomputer centers funded by the NSF and dedicated to providing XSEDE services (Comet at San Diego Supercomputer Center, Stampede II, etc. at Texas Advanced Computing Center, Bridges at the Pittsburgh Supercomputer Center, and Jetstream at Indiana University); Level 2 (currently 8 sites), facilities that provide some of their services through XSEDE; and Level 3 (currently 25 sites), facilities that are listed as potentially usable by XSEDE investigators.

The target audience for Service Provider surveys is the leadership of the facilities belonging to the XSEDE Service Provider Forum. (See https://www.xsede.org/about/governance/spf).

Data for this project have been collected annually over the last five years through several instruments, as described in Table 3-2 below. The goal for the survey instruments is to preserve longitudinal data collection while adding new questions to explore new areas or to clarify points from prior years. For the first three years a spreadsheet containing the questions were distributed to contacts of record at each Service Provider. Responses were aggregated by SP level and used in the $ROI_{proxy}$ analyses in Table 4-4 through Table 4-8 in the "Results" section below.

Table 3-2. Survey instruments

| Program Year (PY) | Calendar dates Covered | Survey audience | Survey instrument | Notes |
|---|---|---|---|---|
| 4 | 7/1/2014 - 6/30/2015 | L1-L3 Service Provider contacts of record | Appendix I | Initial use of spreadsheet instrument for PY4 and PY5 |
| 5 | 7/1/2015 - 8/30/2016 | L1-L3 Service Provider contacts of record | Appendix I | Initial use of spreadsheet instrument for PY4 and PY5 |
| 6 | 9/1/2016 – 8/31/2017 | L1-L3 Service Provider contacts of record | Appendix I | Same instrument as PY4,5 used, updated to indicate PY6 |
| 7 | 9/1/2017 - 8/30/2018 | L1-L3 Service Provider contacts of record | Appendix II | Qualtrics interactive survey used based on spreadsheet instrument from PY6 |
| 8 | 9/1/2018 - 8/30/2019 | L1-L3 Service Provider contacts of record | Appendix II | Qualtrics interactive survey used, updated with additional open-ended questions |

## *3.2 End-user measures of usage*

In order to determine usage and perceived value to investigators for XSEDE's Help Desk, ECSS and Training services, data were requested from each of these groups for PY4 through PY8. Each group compiled this data using their own data collection techniques. For the Help Desk, statistics about how many tickets were responded to by XSEDE on behalf of Service Providers and valued at a standard per-ticket rate of $15.56 to $22.00 depending on the Program Year. Training services were valued by hours of training delivered multiplied by commercial proxy rates of $11.29 per student-hour for in-person training and $9.98 per student-hour for on-line education. ECSS values were estimated by the ECSS project end survey, in which users were asked to estimate how many person months it would have taken to complete their project without ECSS help. The monthly rate is based on Bureau of Labor Statistics nominal rates for similar engineering work. Table 4-9 through Table 12-1 provide details on how these proxy costs were developed.

# 4 Results and Analysis

In order to determine and evaluate the return part of the $ROI_{proxy}$ equation, a survey instrument was sent to XSEDE Service Providers at all three levels: Level 1, or primary NSF funded supercomputer sites; Level 2, or sites with some NSF funded resources that have been dedicated to XSEDE; and Level 3 sites, with services provided "voluntarily" to the XSEDE community. Summary expenses and value generated for all SP types and core XSEDE services are included in Table 4-1, and further detailed and costed by Program Year in Table 4-4 through Table 4-8 below. Amounts for annual "investment" shown in the row labeled "XSEDE Total Expenditure" are detailed in Table 4-4 to Table 4-8 columns labeled "Total Resource Expenses". Further details about valuation of return measures are given in the dataset, tabs 2 through 13 (see reference [14])

Table 4-1. Summary Expense and Value Amounts and XSEDE $ROI_{proxy}$ for PY4-8

| XSEDE Return on Investment (Project Years 4-8) | | | | | | |
|---|---|---|---|---|---|---|
| Category of Value (Proxy for Return) | PY4 Jul14-Jun15 | PY5 Jul15-Aug16 | PY6 Sep16-Aug17 | PY7 Sep17-Aug18 | PY8 Sep18-Aug19 | Combined PY4-PY8 |
| XSEDE value to L1 SPs | $15,948,215 | $12,818,846 | $7,241,488 | $10,207,774 | $12,118,883 | $58,335,206 |
| XSEDE value to L2 SPs | $1,104,111 | $1,107,633 | $1,753,718 | $5,056,986 | $4,221,851 | $13,244,299 |
| XSEDE value to L3 SPs | $756,097 | $949,783 | $6,424,825 | $6,135,790 | $6,288,023 | $20,554,518 |
| *XSEDE value to SPs Subtotal* | *$17,808,423* | *$14,876,262* | *$15,420,031* | *$21,400,550* | *$22,628,757* | $92,134,023 |
| | | | | | | |
| ECSS value to PIs | $7,822,617 | $14,912,466 | $9,032,970 | $12,165,786 | $11,797,278 | $55,731,118 |
| *Extended Support value Subtotal* | | | | | | |
| | | | | | | |
| Helpdesk value | NA | $101,156 | $112,281 | $125,320 | $120,077 | $458,834 |
| *Operations value Subtotal* | | | | | | |
| | | | | | | |
| Training value | $546,680 | $828,359 | $549,190 | $585,134 | $599,745 | $3,109,107 |
| *Training value Subtotal* | | | | | | |
| | | | | | | |
| CRI Software Distribution | $29,393 | $33,969 | $41,961 | $48,259 | $35,945 | $189,527 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CRI Site Visits | $39,667 | $115,910 | $120,722 | $236,626 | $191,351 | $704,276 |
| *Resource Integration Subtotal* | $69,060 | $149,879 | $162,683 | $284,885 | *$227,296* | *$893,803* |
| | | | | | | |
| XSEDE Total Proxy Value | $26,246,780 | $30,868,122 | $25,277,155 | $34,561,675 | $35,373,153 | $152,326,885 |
| XSEDE Total Expenditure | $23,562,931 | $23,067,000 | $18,285,622 | $19,561,588 | $19,993,698 | $104,470,839 |
| XSEDE Total $ROI_{proxy}$ | 1.11 | 1.34 | 1.38 | 1.77 | 1.77 | 1.46 |

## *4.1 Guide to the study dataset*

The study dataset is available as a separate spreadsheet at reference [14] consisting of fifteen tabs. Table 4-2 below lists the content of each tab.

Table 4-2. Dataset tab contents

| Data set tab label | Sheet contents |
|---|---|
| 0. Introduction | Title, authors, XSEDE references and this table |
| 1. Total ROI | Calculation of ROI across all investment and return measures |
| 2. SP PY4 | Program Year 4 SP survey analysis |
| 3. SP PY5 | Program Year 5 SP survey analysis |
| 4. SP PY6 | Program Year 6 SP survey analysis |
| 5. SP PY7 | Program Year 7 SP survey analysis |
| 6. SP PY8 | Program Year 8 SP survey analysis |
| 7. ECSS | Valuation of ECSS to users |
| 8. Training | Valuation of Training to users |
| 9. Helpdesk | Valuation of Helpdesk support to users |
| 10. CRI | Valuation of Campus Bridging and software repository to campuses |
| 11. Expenses | Salary and total cost to XSEDE for staff |
| 12. Costs | Proxy cost measures for CRI, ECSS, Helpdesk, and Training |
| 13. Cost Details | Cost basis information for tab 12 |
| 14. Response Rate | Response rate for the surveys |

## *4.2 Costing data for XSEDE staff labor*

The analysis of $ROI_{proxy}$ is based on a view of what value a Service Provider or end-user receives for a "unit of service" provided by XSEDE. The services are aligned with the XSEDE Work Breakdown Structure (WBS) [6] and costs are drawn from expenditures associated with the WBS block associated with the service. Each service is assigned a number of Full Time Equivalent employees

and cost per FTE, per Program Year. These expenditure allocations are shown in Table 16.

For the "Service Providers" survey, each SP was asked, as an organization that consumes services from XSEDE, to estimate how many FTEs XSEDE saved them from allocating and paying for to provide to the SP's clients each of those services. The per-FTE value from XSEDE's expenditures is used to value that "return".

The following services available to SPs and end users are considered as generating value.

Of value primarily to SPs:

- Account Management and Authentication Services
- 24x7 Operations
- User Survey
- XSEDE Leadership team
- Project Management and Financial Functions
- Network
- Systems Engineering and Deployment

Of value primarily to end users:

- Training and Education
- Parallel Computing Support, Advanced Support, Consultation, and Programming (ECSS)
- Outreach

Of value to both SPs and end users:

- Help Desk ticket Support
- User Information Services, including XSEDE.org
- Allocations (of XSEDE computing and storage to users and SPs)

The "investment" part of the analysis for a given service is the total funding for staff and incidentals that went into providing that service by XSEDE. These amounts, as reported by the XSEDE Program Office, are shown in Table 4-1.

Table 4-9 through Table 12-1 in Appendices V, VI and VII provide the details of how the proxies for value of services to end users was calculated. These services were the XSEDE Help Desk and trouble ticket system, consulting provided by the Extended Collaborative Support Services (ECSS) program, on-line and in-person training provided by the XSEDE Training and outreach group, and software and on-site consulting services provided by the Cyberinfrastructure Resource Integration team (CRI).

### *4.3 Format and contents of the ROI tables for PY4-8 – Value to Service Providers*

Table 4-4 through Table 4-8 contain analyses of Service Provider surveys for each program year, organized by SP Level. The "Resource" column contains services provided by XSEDE to the SPs, columns 2-4 are cost bases for computing investment amounts. For each "Resource" or service in the leftmost column, the total number of FTEs allocated to the resource, cost per FTE, and total cost are listed. Staffing and cost are determined from a Work Breakdown Structure (WBS) map and funding per WBS block provided in Appendix V. The analysis for PY4 and PY5 are based on budgeted expenses, and on actual expenditures for PY6 through PY8.

Valuations in columns under "Level 1/2/3 Service Providers" are computations of returns on the XSEDE investment per service, based on the proxy measure for return of staff FTEs saved (i.e. not allocated) by the SPs as a result of use of XSEDE services. These returns (in FTEs) are given in columns named "Average FTEs per SP". The cash value of the return is computed using the per-FTE cost to XSEDE for that service multiplied by the average FTE and extrapolated to the total number of SPs at a given level indicated by "N=". Some surveys were returned with some responses blank. Where responses were not given to a survey question by an SP regarding the FTEs saved by XSEDE resources a zero was assumed to be the response. For these questions when *no* responses were given to *any* question about resource categories then the entire survey was not included in the data.

Table 4-3. Base investment amounts per XSEDE activity area considered by Program Year

| | PY4 | | | PY5 | | | PY6 | | | PY7 | | | PY8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Resource ** | Actual Cost/FTE | Budgeted FTEs | Total Resource Expenses | Actual Cost/FTE | Budgeted FTEs | Total Resource Expenses | Actual Cost/FTE | Actual FTEs | Total Resource Expenses | Actual Cost/FTE | Actual FTEs | Total Resource Expenses | Actual Cost/FTE | Actual FTEs | Total Resource Expenses |
| Allocations | $209,302.33 | 2.15 | $450,000.00 | $209,302.33 | 2.15 | $450,000 | $153,104 | 2.34 | $358,264 | $163,016 | 2.34 | $381,458 | $163,111 | 2.35 | $383,310 |
| Account Management and Authentication Services | $200,000.00 | 2.85 | $570,000.00 | $200,000.00 | 2.85 | $570,000 | $132,683 | 5.52 | $732,411 | $186,325 | 5.27 | $981,934 | $201,088 | 5.50 | $1,105,984 |
| 24x7 Operations | $196,593.38 | 19.99 | $3,930,000.00 | $216,739.13 | 18.40 | $3,988,000 | $197,349 | 14.59 | $2,879,329 | $202,878 | 15.19 | $3,081,713 | $228,115 | 14.51 | $3,309,954 |
| Ticket Support | $196,593.38 | * | * | $216,739.13 | * | * | $197,349 | * | * | $202,878 | * | * | $228,115 | * | * |
| User Survey | $237,949.50 | 1.31 | $311,000.00 | $237,404.58 | 1.31 | $311,000 | $79,239 | 3.00 | $237,717 | $119,499 | 3.18 | $380,006 | $116,454 | 3.23 | $376,145 |
| Leadership | $221,021.02 | 6.66 | $1,472,000.00 | $214,031.35 | 7.12 | $1,523,903 | $272,772 | 7.57 | $2,064,882 | $347,626 | 6.76 | $2,349,954 | $354,514 | 6.93 | $2,456,782 |
| Project Management and Financial Functions | $200,000.00 | 4.50 | $900,000.00 | $200,020.12 | 4.81 | $962,097 | $242,873 | 6.10 | $1,481,524 | $220,703 | 6.17 | $1,361,737 | $200,292 | 5.98 | $1,197,749 |
| User Information Services, including XSEDE.org | $200,000.00 | 6.36 | $1,272,000.00 | $200,000.00 | 6.00 | $1,200,000 | $126,416 | 4.48 | $566,345 | $115,749 | 4.48 | $518,556 | $202,237 | 3.73 | $754,344 |
| Training and Education | $218,902.61 | 6.51 | $1,425,056.00 | $218,045.11 | 6.65 | $1,450,000 | $150,549 | 8.38 | $1,261,600 | $147,820 | 8.37 | $1,237,253 | $168,888 | 9.00 | $1,519,990 |
| Outreach | $236,713.01 | 9.53 | $2,255,875.00 | $238,512.04 | 9.14 | $2,180,000 | $209,476 | 4.30 | $900,747 | $251,096 | 4.01 | $1,006,896 | $253,573 | 3.97 | $1,006,684 |
| Network | $196,593.38 | * | * | $216,739.13 | * | * | $197,349 | * | * | $202,878 | * | * | $228,115 | * | * |
| Systems Engineering and Deployment | $201,019.62 | 17.83 | $3,585,000.00 | $201,114.02 | 15.26 | $3,069,000 | $214,955 | 8.44 | $1,814,219 | $201,770 | 9.23 | $1,862,341 | $214,570 | 8.76 | $1,879,629 |
| Parallel Computing Support, Advanced Support, Consultation, and Programming | $207,008.09 | 35.71 | $7,392,000.00 | $207,000.28 | 35.57 | $7,363,000 | $225,899 | 26.51 | $5,988,584 | $244,494 | 25.93 | $6,339,740 | $221,436 | 27.11 | $6,003,127 |
| **Totals** | | *113.40* | *$23,562,931.00* | | *109.26* | *$23,067,000* | | *91.23* | *$18,285,622* | | *90.93* | *$19,501,588* | | *91.07* | *$19,993,698* |

***** FTEs, budgets, and expenses for Network and Ticket Support services are included in the Operations budget line.
** Budget, expenses and FTE values provided by the XSEDE Project Office; all other data reported by SPs

Table 4-4. PY4 Service Provider $ROI_{proxy}$ Analysis**

| XSEDE Project Year 4 | | | | Level 1 | | | | | Level 2 | | | | | Level 3 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Resource | Actual Cost/FTE | Budgeted FTEs | Total Resource Expenses | Average FTEs /SP | L1 SPs Answers | Total Value per L1 SP | Total Value for Surveyed L1 SPs | Total Value for All L1 SPs extrapolated N=5 | Average FTEs /SP | L2 SPs Answers | Total Value per L2 SP | Total Value for Surveyed L2 SPs | Total Value for All L2 SPs extrapolated N=5 | Average FTEs /SP | L3 SPs Answers | Total Value per L3 SP | Total Value for Surveyed L3 SPs | Total Value for All L3 SPs extrapolated N=7 |
| Allocations | $ 209,302.33 | 2.15 | $ 450,000.00 | 2.33 | 3 | $ 488,372 | $ 1,465,116 | $2,441,860 | 0.10 | 5 | $20,930 | $104,651 | $104,651 | 0.20 | 5 | $41,860 | $209,302 | $293,023 |
| Account Management and Authentication Services | $ 200,000.00 | 2.85 | $ 570,000.00 | 0.90 | 3 | $ 180,000 | $540,000 | $900,000 | 0.07 | 5 | $14,000 | $70,000 | $70,000 | 0.00 | 5 | $- | $ - | $ - |
| 24x7 Operations | $ 196,593.38 | 19.99 | $3,930,000.00 | 1.67 | 3 | $ 327,656 | $982,967 | $1,638,278 | 0.02 | 5 | $3,932 | $19,659 | $19,659 | 0.00 | 5 | $- | $ - | $ - |
| Ticket Support | $ 196,593.38 | * | * | 1.03 | 3 | $ 203,146 | $609,439 | $1,015,732 | 0.02 | 5 | $3,932 | $19,659 | $19,659 | 0.00 | 5 | $- | $ - | $ - |
| User Survey | $ 237,949.50 | 1.31 | $311,000.00 | 0.18 | 3 | $ 43,624 | $130,872 | $ 218,120 | 0.01 | 5 | $2,379 | $11,897 | $11,897 | 0.00 | 5 | $- | $ - | $ - |
| Leadership | $ 221,021.02 | 6.66 | $1,472,000.00 | 0.25 | 3 | $ 55,255 | $165,766 | $ 276,276 | 0.07 | 5 | $15,471 | $77,357 | $77,357 | 0.07 | 5 | $15,471 | $77,357 | $108,300 |
| Project Management and Financial Functions | $ 200,000.00 | 4.50 | $ 900,000.00 | 0.50 | 3 | $ 100,000 | $300,000 | $500,000 | 0.04 | 5 | $8,000 | $40,000 | $40,000 | 0.00 | 5 | $- | $ - | $ - |
| User Information Services, including XSEDE.org | $ 200,000.00 | 6.36 | $1,272,000.00 | 0.45 | 3 | $90,000 | $270,000 | $450,000 | 0.00 | 5 | $- | $ - | $- | 0.02 | 5 | $4,000 | $20,000 | $28,000 |
| Training and Education | $ 218,902.61 | 6.51 | $1,425,056.00 | 0.75 | 3 | $164,177 | $492,531 | $820,885 | 0.30 | 5 | $65,671 | $328,354 | $328,354 | 0.17 | 5 | $37,213 | $186,067 | $260,494 |
| Outreach | $ 236,713.01 | 9.53 | $2,255,875.00 | 0.92 | 3 | $216,987 | $650,961 | $1,084,935 | 0.02 | 5 | $4,734 | $23,671 | $23,671 | 0.04 | 5 | $9,469 | $47,343 | $66,280 |
| Network | $ 196,593.38 | * | * | 0.23 | 3 | $45,872 | $137,615 | $229,359 | 0.03 | 5 | $5,898 | $29,489 | $29,489 | 0.00 | 5 | $- | $ - | $ - |
| Systems Engineering and Deployment | $ 201,019.62 | 17.83 | $3,585,000.00 | 0.33 | 3 | $67,007 | $201,020 | $335,033 | 0.12 | 5 | $24,122 | $120,612 | $120,612 | 0.00 | 5 | $- | $ - | $ - |
| Parallel Computing Support, Advanced Support, Consultation, and Programming | $ 207,008.09 | 35.71 | $7,392,000.00 | 5.83 | 3 | $1,207,547 | $3,622,642 | $6,037,736 | 0.25 | 5 | $51,752 | $258,760 | $258,760 | 0.00 | 5 | $- | $ - | $ - |
| Totals | | | $23,562,931.00 | 15.38 | | | $9,568,929 | $15,948,215 | 1.05 | | | $1,104,111 | $1,104,111 | 0.50 | | | $ 540,070 | $ 756,097 |

* FTEs and budgets for Network and Ticket Support services are included in the Operations budget line
** Budget and FTE values provided by the XSEDE Project Office; all other data reported by SPs

Table 4-5. PY5 Service Provider $ROI_{proxy}$ Analysis**

| XSEDE Project Year 5 | | | | Level 1 | | | | | Level 2 | | | | | Level 3 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Resource ** | Actual Cost/FTE | Budgeted FTEs | Total Resource Expenses | Average FTEs /SP | L1 SPs Answered | Total Value per L1 SP | Total Value for Surveyed L1 SPs | Total Value for All L1 SPs extrapolated N=5 | Average FTEs /SP | L2 SPs Answered | Total Value per L2 SP | Total Value for Surveyed L2 SPs | Total Value for All L2 SPs extrapolated N=5 | Average FTEs /SP | L3 SPs Answered | Total Value per L3 SP | Total Value for Surveyed L3 SPs | Total Value for All L3 SPs extrapolated N=7 |
| Allocations | $209,302.33 | 2.15 | $450,000.00 | 1.81 | 4 | $379,360 | $1,517,442 | $1,896,802 | 0.10 | 5 | $20,930 | $104,651 | $104,651 | 0.14 | 7 | $29,900 | $ 209,302 | $209,302 |
| Account Management and Authentication Services | $200,000.00 | 2.85 | $570,000.00 | 0.80 | 4 | $160,000 | $640,000 | $800,000 | 0.07 | 5 | $14,000 | $70,000 | $70,000 | 0.00 | 7 | $ - | $ - | $ - |
| 24x7 Operations | $216,739.13 | 18.40 | $3,988,000.00 | 1.25 | 4 | $270,924 | $1,083,696 | $1,354,620 | 0.02 | 5 | $4,335 | $21,674 | $21,674 | 0.00 | 7 | $ - | $ - | $ - |
| Ticket Support | $216,739.13 | * | * | 0.96 | 4 | $208,611 | $834,446 | $1,043,057 | 0.02 | 5 | $4,335 | $21,674 | $21,674 | 0.00 | 7 | $ - | $ - | $ - |
| User Survey | $237,404.58 | 1.31 | $311,000.00 | 0.20 | 4 | $47,481 | $189,924 | $237,405 | 0.01 | 5 | $2,374 | $11,870 | $11,870 | 0.01 | 7 | $3,391 | $23,740 | $23,740 |
| Leadership | $214,031.35 | 7.12 | $1,523,903.23 | 0.21 | 4 | $45,482 | $181,927 | $227,408 | 0.07 | 5 | $14,982 | $74,911 | $74,911 | 0.11 | 7 | $24,461 | $171,225 | $171,225 |
| Project Management and Financial Functions | $200,020.12 | 4.81 | $962,096.77 | 0.38 | 4 | $75,008 | $300,030 | $375,038 | 0.04 | 5 | $8,001 | $40,004 | $40,004 | 0.00 | 7 | $ - | $ - | $ - |
| User Information Services, including XSEDE.org | $200,000.00 | 6.00 | $1,200,000.00 | 0.40 | 4 | $80,000 | $320,000 | $400,000 | 0.00 | 5 | $- | $ - | $- | 0.04 | 7 | $8,571 | $60,000 | $60,000 |
| Training and Education | $218,045.11 | 6.65 | $1,450,000.00 | 0.59 | 4 | $128,102 | $512,406 | $640,508 | 0.30 | 5 | $65,414 | $327,068 | $327,068 | 0.17 | 7 | $ 37,379 | $261,654 | $261,654 |
| Outreach | $238,512.04 | 9.14 | $2,180,000.00 | 0.71 | 4 | $169,940 | $679,759 | $849,699 | 0.02 | 5 | $4,770 | $23,851 | $23,851 | 0.04 | 7 | $10,222 | $71,554 | $71,554 |
| Network | $216,739.13 | * | * | 0.18 | 4 | $37,929 | $151,717 | $189,647 | 0.03 | 5 | $6,502 | $32,511 | $32,511 | 0.00 | 7 | $ - | $ - | $ - |
| Systems Engineering and Deployment | $201,114.02 | 15.26 | $3,069,000.00 | 0.28 | 4 | $55,306 | $221,225 | $276,532 | 0.12 | 5 | $24,134 | $120,668 | $120,668 | 0.07 | 7 | $ 14,365 | $100,557 | $100,557 |
| Parallel Computing Support, Advanced Support, Consultation, and Programming (e.g., value of ECSS to your SP) | $207,000.28 | 35.57 | $7,363,000.00 | 4.38 | 4 | $905,626 | $3,622,505 | $4,528,131 | 0.25 | 5 | $51,750 | $258,750 | $258,750 | 0.04 | 7 | $7,393 | $51,750 | $51,750 |
| Totals | | 109.26 | $23,067,000.00 | 12.14 | | | $10,255,077 | $12,818,846 | 1.05 | | | $1,107,633 | $1,107,633 | 0.64 | | | $949,783 | $949,783 |

* FTEs and budgets for Network and Ticket Support services are included in the Operations budget line
** Budget and FTE values provided by the XSEDE Project Office; all other data reported by SPs

Table 4-6. PY6 Service Provider $ROI_{proxy}$ Analysis**

| XSEDE Project Year 6 | | | | Level 1 | | | | | Level 2 | | | | | Level 3 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Resource | Actual Cost/FTE | Actual FTEs | Total Resource Expenses | Average FTEs/SP | L1 SPs Answered | Total Value per L1 SP | Total Value for Surveyed L1 SPs | Total Value for All L1 SPs extrapolated N=4 | Average FTEs/SP | L2 SPs Answered | Total Value per L2 SP | Total Value for Surveyed L2 SPs | Total Value for All L2 SPs extrapolated N=8 | Average FTEs/SP | L3 SPs Answered | Total Value per L3 SP | Total Value for Surveyed L3 SPs | Total Value for All L3 SPs extrapolated N=21 |
| Allocations | $ 153,104 | 2.34 | $ 358,264 | 1.88 | 4 | $ 287,071 | $ 1,148,282 | $1,148,282 | 0.25 | 2 | $ 38,276 | $76,552 | $ 306,209 | 0.03 | 13 | $ 4,711 | $ 61,242 | $ 98,929 |
| Account Management and Authentication Services | $ 132,683 | 5.52 | $ 732,411 | 0.36 | 4 | $ 48,098 | $ 192,391 | $ 192,391 | 0.00 | 2 | $ - | $ - | $ - | 0.10 | 13 | $ 13,268 | $ 172,488 | $ 278,635 |
| 24x7 Operations | $ 197,349 | 14.59 | $ 2,879,329 | 0.30 | 4 | $ 59,205 | $ 236,819 | $ 236,819 | 0.01 | 2 | $ 987 | $ 1,973 | $ 7,894 | 0.02 | 13 | $ 3,036 | $ 39,470 | $ 63,759 |
| Ticket Support | $ 197,349 | * | * | 0.34 | 4 | $ 66,605 | $ 266,422 | $ 266,422 | 0.05 | 2 | $ 9,867 | $19,735 | $ 78,940 | 0.02 | 13 | $ 3,947 | $ 51,311 | $ 82,887 |
| User Survey | $ 79,239 | 3.00 | $ 237,717 | 0.18 | 4 | $ 13,867 | $ 55,467 | $ 55,467 | 0.25 | 2 | $ 19,810 | $39,620 | $158,478.00 | 0.03 | 13 | $ 2,743 | $ 35,658 | $ 57,601 |
| Leadership | $ 272,772 | 7.57 | $ 2,064,882 | 0.24 | 4 | $ 64,783 | $ 259,133 | $ 259,133 | 0.13 | 2 | $ 34,096 | $68,193 | $ 272,772 | 0.30 | 13 | $ 81,412 | $1,058,354 | $ 1,709,649 |
| Project Management and Financial Functions | $ 242,873 | 6.10 | $ 1,481,524 | 0.24 | 4 | $ 57,682 | $ 230,729 | $ 230,729 | 0.03 | 2 | $ 6,072 | $12,144 | $ 48,574.56 | 0.00 | 13 | $ 934 | $ 12,144 | $ 19,617 |
| User Information Services, including XSEDE.org | $ 126,416 | 4.48 | $ 566,345 | 0.26 | 4 | $ 33,184 | $ 132,737 | $ 132,737 | 0.13 | 2 | $ 15,802 | $31,604 | $ 126,416.29 | 0.10 | 13 | $ 12,739 | $ 165,605 | $ 267,516 |
| Training and Education | $ 150,549 | 8.38 | $ 1,261,600 | 0.75 | 4 | $ 112,912 | $ 451,647 | $ 451,647 | 0.25 | 2 | $ 37,637 | $75,274 | $ 301,097.85 | 0.41 | 13 | $ 62,304 | $ 809,953 | $ 1,308,386 |
| Outreach | $ 209,476 | 4.30 | $ 900,747 | 0.71 | 4 | $ 149,252 | $ 597,007 | $ 597,007 | 0.13 | 2 | $ 26,185 | $52,369 | $ 209,476.05 | 0.15 | 13 | $ 31,744 | $ 412,668 | $ 666,617 |
| Network | $ 197,349 | * | * | 0.08 | 4 | $ 14,801 | $ 59,205 | $ 59,205 | 0.10 | 2 | $ 19,735 | $39,470 | $ 157,879.59 | 0.13 | 13 | $ 25,048 | $ 325,627 | $ 526,012 |
| Systems Engineering and Deployment | $ 214,955 | 8.44 | $ 1,814,219 | 0.06 | 4 | $ 13,435 | $ 53,739 | $ 53,739 | 0.05 | 2 | $ 10,748 | $21,495 | $ 85,981.94 | 0.07 | 13 | $ 14,881 | $ 193,459 | $ 312,511 |
| Parallel Computing Support, Advanced Support, Consultation, and Programming | $ 225,899 | 26.51 | $ 5,988,584 | 3.94 | 4 | $ 889,478 | $ 3,557,910 | $3,557,910 | 0.00 | 2 | $ - | $ - | $ - | 0.22 | 13 | $ 49,176 | $ 639,294 | $ 1,032,706 |
| **Totals** | | 91.23 | $18,285,622 | 9.33 | | | $ 7,241,488 | $7,241,488 | 1.36 | | | $438,430 | $ 1,753,718 | 1.58 | | | $3,977,273 | $ 6,424,825 |

* FTEs and budgets for Network and Ticket Support services are included in the Operations budget line
** Expenses and FTE values provided by the XSEDE Project Office; all other data reported by SPs

Table 4-7. PY7 Service Provider $ROI_{proxy}$ Analysis**

| XSEDE Project Year 7 | | | | Level 1 | | | | | Level 2 | | | | | Level 3 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Resource | Actual Cost/FTE | Actual FTEs | Total Resource Expenses | Average FTEs/SP | L1 SPs Answered | Total Value per L1 SP | Total Value for Surveyed L1 SPs | Total Value for All L1 SPs extrapolated N=4 | Average FTEs/SP | L2 SPs Answered | Total Value per L2 SP | Total Value for Surveyed L2 SPs | Total Value for All L2 SPs extrapolated N=9 | Average FTEs/SP | L3 SPs Answered | Total Value per L3 SP | Total Value for Surveyed L3 SPs | Total Value for All L3 SPs extrapolated N=23 |
| Allocations | $ 163,016 | 2.34 | $ 381,458 | 1.75 | 4 | $ 285,278 | $ 1,141,114 | $ 1,141,114 | 0.38 | 8 | $61,131 | $ 489,049 | $550,180 | 0.20 | 13 | $32,603 | $ 423,842 | $ 749,875 |
| Account Management and Authentication Services | $ 186,325 | 5.27 | $ 981,934 | 1.11 | 4 | $ 207,287 | $ 829,147 | $ 829,147 | 0.13 | 8 | $23,524 | $ 188,188 | $211,712 | 0.12 | 13 | $ 21,642 | $ 281,351 | $ 497,775 |
| 24x7 Operations | $ 202,878 | 15.19 | $ 3,081,713 | 0.25 | 4 | $ 50,719 | $ 202,878 | $ 202,878 | 0.25 | 8 | $50,973 | $ 407,784 | $458,757 | 0.05 | 13 | $ 9,832 | $ 127,813 | $ 226,131 |
| Ticket Support | $ 202,878 | * | * | 0.33 | 4 | $ 65,935 | $ 263,741 | $ 263,741 | 0.20 | 8 | $ 39,561 | $ 316,489 | $356,050 | 0.05 | 13 | $ 9,676 | $ 125,784 | $ 222,541 |
| User Survey | $ 119,499 | 3.18 | $ 380,006 | 0.14 | 4 | $ 16,431 | $ 65,724 | $ 65,724 | 0.10 | 8 | $ 11,352 | $ 90,819 | $102,171 | 0.00 | 13 | $ 460 | $ 5,975 | $ 10,571 |
| Leadership | $ 347,626 | 6.76 | $ 2,349,954 | 0.24 | 4 | $ 82,561 | $ 330,245 | $ 330,245 | 0.13 | 8 | $ 43,888 | $ 351,103 | $394,990 | 0.18 | 13 | $ 62,386 | $ 811,012 | $ 1,434,868 |
| Project Management and Financial Functions | $ 220,703 | 6.17 | $ 1,361,737 | 0.13 | 4 | $ 27,588 | $ 110,351 | $ 110,351 | 0.06 | 8 | $ 14,070 | $ 112,558 | $126,628 | 0.00 | 13 | $ - | $ - | $ - |
| User Information Services, including XSEDE.org | $ 115,749 | 4.48 | $ 518,556 | 0.33 | 4 | $ 37,618 | $ 150,474 | $ 150,474 | 0.26 | 8 | $ 30,529 | $ 244,231 | $274,759 | 0.13 | 13 | $ 14,869 | $ 193,301 | $ 341,994 |
| Training and Education | $ 147,820 | 8.37 | $ 1,237,253 | 0.94 | 4 | $ 138,581 | $ 554,325 | $ 554,325 | 0.26 | 8 | $ 38,248 | $ 305,987 | $344,236 | 0.29 | 13 | $ 42,788 | $ 556,246 | $ 984,128 |
| Outreach | $ 251,096 | 4.01 | $ 1,006,896 | 0.78 | 4 | $ 194,600 | $ 778,398 | $ 778,398 | 0.41 | 8 | $ 102,636 | $ 821,085 | $923,720 | 0.18 | 13 | $ 45,390 | $ 590,076 | $ 1,043,981 |
| Network | $ 202,878 | * | * | 0.30 | 4 | $ 60,863 | $ 243,453 | $ 243,453 | 0.16 | 8 | $ 31,953 | $ 255,626 | $287,579 | 0.00 | 13 | $ 156 | $ 2,029 | $ 3,589 |
| Systems Engineering and Deployment | $ 201,770 | 9.23 | $ 1,862,341 | 0.50 | 4 | $ 100,885 | $ 403,541 | $ 403,541 | 0.06 | 8 | $ 12,863 | $ 102,903 | $115,766 | 0.02 | 13 | $ 4,967 | $ 64,567 | $ 114,233 |
| Parallel Computing Support, Advanced Support, Consultation, and Programming (e.g., value of ECSS to your SP) | $ 244,494 | 25.93 | $ 6,339,740 | 5.25 | 4 | $1,283,596 | $ 5,134,383 | $ 5,134,383 | 0.41 | 8 | $101,160 | $ 809,276 | $910,436 | 0.09 | 13 | $ 22,004 | $ 286,058 | $ 506,103 |
| **Totals** | | 90.93 | $19,501,588 | 12.03 | | | $10,207,774 | $ 10,207,774 | 2.80 | | | $4,495,099 | $ 5,056,986 | 1.31 | | | $3,468,055 | $ 6,135,790 |

* FTEs and budgets for Network and Ticket Support services are included in the Operations budget line
** Expenses and FTE values provided by the XSEDE Project Office; all other data reported by SPs

Table 4-8. PY8 Service Provider $ROI_{proxy}$ Analysis**

| XSEDE Project Year 8 | | | | Level 1 | | | | | Level 2 | | | | | Level 3 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Resource | Actual Cost/FTE | Actual FTEs | Total Resource Expenses | Average FTEs/SP | L1 SPs Answered | Total Value per L1 SP | Total Value for Surveyed L1 SPs | Total Value for All L1 SPs extrapolated N=4 | Average FTEs/SP | L2 SPs Answered | Total Value per L2 SP | Total Value for Surveyed L2 SPs | Total Value for All L2 SPs extrapolated N=8 | Average FTEs/SP | L3 SPs Answered | Total Value per L3 SP | Total Value for Surveyed L3 SPs | Total Value for All L3 SPs extrapolated N=25 |
| Allocations | $ 163,111 | 2.35 | $ 383,310 | 2.38 | 4 | $ 387,388 | $ 1,549,551 | $ 1,549,551 | 0.20 | 6 | $ 32,622 | $ 195,733 | $260,977 | 0.04 | 17 | $ 5,757 | $ 97,866 | $ 143,921 |
| Account Management and Authentication Services | $ 201,088 | 5.50 | $ 1,105,984 | 1.30 | 4 | $ 261,414 | $ 1,045,658 | $ 1,045,658 | 0.03 | 6 | $ 6,703 | $ 40,218 | $53,623 | 0.06 | 17 | $ 13,012 | $ 221,197 | $ 325,289 |
| 24x7 Operations | $ 228,115 | 14.51 | $ 3,309,954 | 0.38 | 4 | $ 85,543 | $ 342,173 | $ 342,173 | 0.00 | 6 | $ - | $ - | $0 | 0.01 | 17 | $ 1,342 | $ 22,812 | $ 33,546 |
| Ticket Support | $ 228,115 | * | * | 0.36 | 4 | $ 82,692 | $ 330,767 | $ 330,767 | 0.00 | 6 | $ - | $ - | $0 | 0.05 | 17 | $ 11,943 | $ 203,023 | $ 298,563 |
| User Survey | $ 116,454 | 3.23 | $ 376,145 | 0.18 | 4 | $ 20,379 | $ 81,517 | $ 81,517 | 0.00 | 6 | $ - | $ - | $0 | 0.02 | 17 | $ 1,850 | $ 31,442 | $ 46,239 |
| Leadership | $ 354,514 | 6.93 | $ 2,456,782 | 0.31 | 4 | $ 110,786 | $ 443,142 | $ 443,142 | 0.37 | 6 | $ 129,988 | $ 779,931 | $1,039,908 | 0.14 | 17 | $ 50,049 | $ 850,834 | $ 1,251,226 |
| Project Management and Financial Functions | $ 200,292 | 5.98 | $ 1,197,749 | 0.25 | 4 | $ 50,073 | $ 200,292 | $ 200,292 | 0.00 | 6 | $ - | $ - | $0 | 0.00 | 17 | $ - | $ - | $ - |
| User Information Services, including XSEDE.org | $ 202,237 | 3.73 | $ 754,344 | 0.55 | 4 | $ 111,230 | $ 444,921 | $ 444,921 | 0.02 | 6 | $ 3,371 | $ 20,224 | $26,965 | 0.15 | 17 | $ 30,217 | $ 513,682 | $ 755,415 |
| Training and Education | $ 168,888 | 9.00 | $ 1,519,990 | 1.13 | 4 | $ 189,999 | $ 759,995 | $ 759,995 | 0.42 | 6 | $ 70,370 | $ 422,219 | $562,959 | 0.42 | 17 | $ 70,337 | $ 1,195,725 | $ 1,758,420 |
| Outreach | $ 253,573 | 3.97 | $ 1,006,684 | 1.00 | 4 | $ 253,573 | $ 1,014,291 | $ 1,014,291 | 0.23 | 6 | $ 57,054 | $ 342,323 | $456,431 | 0.13 | 17 | $ 32,517 | $ 552,789 | $ 812,925 |
| Network | $ 228,115 | * | * | 0.36 | 4 | $ 82,692 | $ 330,767 | $ 330,767 | 0.42 | 6 | $ 95,048 | $ 570,288 | $760,385 | 0.05 | 17 | $ 10,601 | $ 180,211 | $ 265,016 |
| Systems Engineering and Deployment | $ 214,570 | 8.76 | $ 1,879,629 | 0.56 | 4 | $ 120,695 | $ 482,781 | $ 482,781 | 0.04 | 6 | $ 8,940 | $ 53,642 | $71,523 | 0.01 | 17 | $ 2,146 | $ 36,477 | $ 53,642 |
| Parallel Computing Support, Advanced Support, Consultation, and Programming | $ 221,436 | 27.11 | $ 6,003,127 | 5.75 | 4 | $ 1,273,256 | $ 5,093,025 | $ 5,093,025 | 0.56 | 6 | $ 123,635 | $ 741,810 | $989,080 | 0.10 | 17 | $ 21,753 | $ 369,798 | $ 543,820 |
| **Totals** | | 91.07 | $19,993,698 | 14.50 | | | $ 12,118,883 | $ 12,118,883 | 2.28 | | | $3,166,389 | $ 4,221,851 | 1.16 | | | $ 4,275,855 | $ 6,288,023 |

* FTEs and budgets for Network and Ticket Support services are included in the Operations budget line
** Expenses and FTE values provided by the XSEDE Project Office; all other data reported by SPs

### *4.4 Value to end users of Training, ECSS consulting, CRI software and consulting*

In addition to the value provided to Service Providers by XSEDE a component of the study is to understand the value of XSEDE services to end-users. Three services are primarily for and used by XSEDE's account holders and users of computing resources: training [7], in-depth consulting (Extended Collaborative Support Services, ECSS) [8], and Cyberinfrastructure Resource Integration software and on-campus consulting (CRI). [9]

Training and CRI each provide two sub-services: training content available for in-person and asynchronous on-line use; and CRI provides a repository of software for campuses to build XSEDE-like environments locally, and also helps local research support staff solve hardware and software problems on-site at campuses across the country.

Each of these services was analyzed for return on investment using the following measures. See Table 10-1 and Table 11-1 in Appendices VI and VII for details of cost proxies. The return amounts in dollars for each of these services per Program Year are included in Table 4-1 above.

- *Training, in-person*: return is number of class attendee-hours multiplied by a proxy cost for in-person training from a commercial IT training company.
- *Training, asynchronous/self-paced*: return is person-uses of XSEDE self-paced classes multiplied by a proxy cost for self-paced training from a commercial IT training company
- Counts of training person-hours and on-line training module uses were provided by the XSEDE training group. Investment is the labor expenditure for the training group.
- *Extended Collaborative Support Services*: return is the estimated time saved by end-users in developing their projects with ECSS assistance vs. without.
- ECSS "time saved" numbers are from interviews with project teams at the close of an ECSS engagement. Time saved is defined as the number of months it would have taken them to achieve the same result without ECSS' help. Time saved is multiplied by labor costs (with benefits) for similar IT professional roles from the Bureau of Labor Statistics (see Appendix VII).
- *CRI software repository*: return is number of package downloads multiplied by a cost factor representing hours saved by the system administrator in using the pre-packaged and configured software vs. installing it from original sources. The cost factor currently is 0.5 hour per package.
- *CRI on-campus CI consulting and implementation assistance*: return is time saved by local research computing staff in performing the tasks needed to achieve their goals for campus CI vs. attempting the same without CRI assistance multiplied by a labor cost with benefits for similar IT professional roles (see Appendix VII for costs).

Details of the costs for ECSS labor for PY4-PY8 are shown in Table 4-9 below. The "Value" column contains the assessed value to ECSS clients and is used in the $ROI_{proxy}$ calculations for ECSS in Table 4-1 above. Additional details about PIs and projects can be found in the study data set. [14]

Table 4-9. Cost calculations for ECSS value, PY4 to PY8

| PI* | Timeframe ** | WBS*** | Months saved (months taken - 3) | Months it would have taken | Person Years | Value**** |
|---|---|---|---|---|---|---|
| PY4-PI1 | 6/25/15 | ESSGW | 9 | 12 | | |
| PY4-PI2 | 2/3/15 | ESCC | -3 | 0 | | |
| PY4-PI3 | 1/20/15 | ESRT | 3 | 6 | | |
| PY4-PI4 | 12/17/14 | ESCC | 21 | 24 | | |
| PY4-PI5 | 12/11/14 | ESSGW | 9 | 12 | | |
| PY4-PI6 | 12/4/14 | ESCC | 0 | 3 | | |
| PY4-PI7 | 11/25/14 | ESCC | -3 | 0 | | |
| PY4-PI8 | 10/29/14 | ESSGW | 0 | 3 | | |
| PY4-PI9 | 10/29/14 | ESSGW | 9 | 12 | | |
| PY4-PI10 | 9/26/14 | ESCC | 3 | 6 | | |
| PY4-PI11 | 9/25/14 | ESCC | 9 | 12 | | |
| PY4-PI12 | 9/24/14 | ESSGW | 9 | 12 | | |
| **PY4 Total** | | Actual | | 102 | 8.50 | $1,444,176 |
| PY4 Projects | 65 | Average | 8.50 | 552.50 | 46.04 | $7,822,617 |
| Salary 2015 | $169,903 | Alternate | | 1.569230769 | 0.13076923 | $22,218 |
| PY5-PI1 | 8/4/16 | ESRT | 21 | 24 | | |
| PY5-PI2 | 7/28/16 | ESRT | 3 | 6 | | |
| PY5-PI3 | 6/9/16 | ESRT | 21 | 24 | | |
| PY5-PI4 | 6/9/16 | ESRT | 0 | 3 | | |
| PY5-PI5 | 5/19/16 | ESSGW | 9 | 12 | | |
| PY5-PI6 | 5/19/16 | ESCC | 11 | 14 | | |
| PY5-PI7 | 5/17/16 | ESSGW | 21 | 24 | | |
| PY5-PI8 | 5/11/16 | ESSGW | 21 | 24 | | |
| PY5-PI9 | 5/9/16 | ESRT | 21 | 24 | | |
| PY5-PI10 | 5/4/16 | ESRT | 3 | 6 | | |
| PY5-PI11 | 5/4/16 | ESCC | 21 | 24 | | |
| PY5-PI12 | 4/8/16 | ESSGW | 10.2 | 13.2 | | |
| PY5-PI13 | 4/6/16 | ESSGW | 21 | 24 | | |
| PY5-PI14 | 4/6/16 | ESCC | 12 | 15 | | |
| PY5-PI15 | 4/5/16 | ESSGW | 15 | 18 | | |
| PY5-PI16 | 3/31/16 | ESCC | -3 | 0 | | |
| PY5-PI17 | 3/29/16 | ESCC | 21 | 24 | | |
| PY5-PI18 | 2/5/16 | ESRT | 9 | 12 | | |
| PY5-PI19 | 1/29/16 | ESRT | 21 | 24 | | |
| PY5-PI20 | 11/23/15 | ESRT | 21 | 24 | | |
| PY5-PI21 | 11/3/15 | ESRT | 21 | 24 | | |
| PY5-PI22 | 10/30/15 | ESRT | 21 | 24 | | |
| PY5-PI23 | 10/26/15 | ESRT | 3 | 6 | | |
| PY5-PI24 | 9/24/15 | ESCC | 21 | 24 | | |
| **PY5 Total** | | Actual | | 417.2 | 34.77 | $6,066,088 |
| PY5 Projects | 59 | Average | 17.38 | 1025.62 | 85.47 | $14,912,466 |
| Salary 2016 | $174,480 | Alternate | | 7.071186441 | 0.58926554 | $102,815 |
| PY6-PI1 | 8/23/17 | ESSGW | 3 | 6 | | |
| PY6-PI2 | 8/22/17 | ESSGW | 21 | 24 | | |
| PY6-PI3 | 8/18/17 | ESCC | -3 | 0 | | |
| PY6-PI4 | 8/7/17 | ESSGW | 21 | 24 | | |
| PY6-PI5 | 8/4/17 | ESSGW | 3 | 6 | | |
| PY6-PI6 | 8/4/17 | ESCC | 9 | 12 | | |
| PY6-PI7 | 7/3/17 | ESRT | 3 | 6 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| PY6-PI8 | 6/14/17 | ESCC | 2 | 5 | | |
| PY6-PI9 | 6/13/17 | ESSGW | 2 | 5 | | |
| PY6-PI10 | 6/13/17 | ESCC | 21 | 24 | | |
| PY6-PI11 | 6/12/17 | ESSGW | 6 | 9 | | |
| PY6-PI12 | 5/1/17 | ESRT | 1.5 | 4.5 | | |
| PY6-PI13 | 5/1/17 | ESRT | 21 | 24 | | |
| PY6-PI14 | 4/27/17 | ESRT | 15 | 18 | | |
| PY6-PI15 | 4/20/17 | ESRT | 21 | 24 | | |
| PY6-PI16 | 3/29/17 | ESRT | 9 | 12 | | |
| PY6-PI17 | 2/10/17 | ESSGW | 6 | 9 | | |
| PY6-PI18 | 2/10/17 | ESCC | -3 | 0 | | |
| PY6-PI19 | 2/7/17 | ESSGW | 9 | 12 | | |
| PY6-PI20 | 2/2/17 | ESCC | -3 | 0 | | |
| PY6-PI21 | 1/26/17 | ESRT | 0 | 3 | | |
| PY6-PI22 | 12/13/16 | ESSGW | 1 | 4 | | |
| PY6-PI23 | 12/13/16 | ESSGW | 21 | 24 | | |
| PY6-PI24 | 12/6/16 | ESSGW | 21 | 24 | | |
| PY6-PI25 | 12/6/16 | ESSGW | 21 | 24 | | |
| PY6-PI26 | 11/12/16 | ESRT | 0 | 3 | | |
| PY6-PI27 | 11/8/16 | ESRT | 1 | 4 | | |
| PY6-PI28 | 9/27/16 | ESSGW | 21 | 24 | | |
| PY6-PI29 | 9/23/16 | ESCC | 3 | 6 | | |
| PY6-PI30 | 9/20/16 | ESCC | 21 | 24 | | |
| PY6-PI31 | 9/12/16 | ESRT | 21 | 24 | | |
| PY6-PI32 | 9/9/16 | ESCC | 0 | 3 | | |
| PY6-PI33 | 9/2/16 | ESSGW | 21 | 24 | | |
| **PY6 Total** | | Actual | | 415.5 | 34.63 | $6,210,167 |
| PY6 Projects | 48 | Average | 12.59 | 604.36 | 50.36 | $9,032,970 |
| Salary 2017 | $179,355 | | | | | |
| | PY7IPR4 | ESRT | 21 | 24 | | |
| | PY7IPR4 | ESRT | 9 | 12 | | |
| | PY7IPR4 | ESRT | 21 | 24 | | |
| | PY7IPR4 | ESRT | 21 | 24 | | |
| | PY7IPR4 | ESRT | 21 | 24 | | |
| PY7-PI1 | PY7IPR4 | ESSGW | 9 | 12 | | |
| | PY7IPR4 | ESSGW | 3 | 6 | | |
| | PY7IPR5 | ESRT | 9 | 12 | | |
| | PY7IPR5 | ESRT | 21 | 24 | | |
| | PY7IPR5 | ESRT | 21 | 24 | | |
| | PY7IPR5 | ESRT | 21 | 24 | | |
| | PY7IPR5 | ESRT | 21 | 24 | | |
| PY7-PI2 | PY7IPR5 | ESCC | 21 | 24 | | |
| | PY7IPR5 | ESCC | 1 | 4 | | |
| PY7-PI3 | PY7IPR5 | ESCC | 2 | 5 | | |
| PY7-PI4 | PY7IPR5 | ESSGW | 6 | 9 | | |
| PY7-PI5 | PY7IPR5 | ESSGW | 3 | 6 | | |
| | PY7Annual | ESRT | 21 | 24 | | |
| | PY7Annual | ESRT | 9 | 12 | | |
| | PY7Annual | ESCC | 12 | 15 | | |
| | PY7Annual | ESCC | 13 | 16 | | |
| | PY7Annual | ESSGW | 21 | 24 | | |
| | PY7Annual | ESSGW | 3 | 6 | | |
| | PY7Annual | ESSGW | 12 | 15 | | |
| PY7-PI6 | PY7IPR7 | ESSGW | 21 | 24 | | |
| **PY7 Total** | | Actual | | 394 | 32.83 | $6,099,613 |
| PY7 Projects | 47 | Average | 16.72 | 785.84 | 65.49 | $12,165,786 |
| Salary 2018 | $185,775 | | | | | |
| PY8-PI1 | PY8IPR7 | ESRT | 11 | 14 | | |
| PY8-PI2 | PY8IPR7 | ESRT | 21 | 24 | | |
| PY8-PI3 | PY8IPR7 | ESRT | 21 | 24 | | |
| PY8-PI4 | PY8IPR7 | ESRT | 21 | 24 | | |
| PY8-PI5 | PY8IPR7 | ESCC | 0 | 3 | | |
| PY8-PI6 | PY8IPR7 | ESSGW | 0 | 3 | | |
| PY8-PI7 | PY8IPR8 | ESRT | 21 | 24 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| PY8-PI8 | PY8IPR8 | ESSGW | 21 | 24 | | |
| PY8-PI9 | PY8IPR8 | ESRT | 21 | 24 | | |
| PY8-PI10 | PY8IPR8 | ESCC | 21 | 24 | | |
| PY8-PI11 | PY8IPR8 | ESSGW | 21 | 24 | | |
| PY8-PI12 | PY8Annual | ESRT | 2 | 5 | | |
| PY8-PI13 | PY8Annual | ESRT | 9 | 12 | | |
| PY8-PI14 | PY8Annual | ESRT | 6 | 9 | | |
| PY8-PI15 | PY8Annual | ESSGW | 21 | 24 | | |
| PY8-PI16 | PY8IPR9 | ESRT | 0 | 3 | | |
| PY8-PI17 | PY8IPR10 | ESSGW | 21 | 24 | | |
| PY8-PI18 | PY8IPR10 | ESSGW | 3 | 6 | | |
| PY8-PI19 | PY8IPR10 | ESCC | 3 | 6 | | |
| PY8-PI20 | PY8IPR10 | ESCC | 9 | 12 | | |
| **PY8 Total** | | Actual | | 313 | 26.08 | $5,020,118 |
| PY8 Projects | 47 | Average | 15.65 | 735.55 | 61.30 | $11,797,278 |
| Salary 2019 | $192,465 | | | | | |

* Principal Investigator identifying number for this project
** Timeframe is approximate calendar end
*** WBS is work breakdown structure bock to which work on the project was assigned (sub-element of ECSS)
**** Value is the total value of the labor cost difference between "without ECSS help" and "with ECSS help" time.

Table 4-10. Training costs used in $ROI_{proxy}$ calculation

| Person-hours of training delivered | | | |
|---|---|---|---|
| | Webinar | Async | Live |
| PY4 | 7984 | 21494 | 22364 |
| PY5 | 2479 | 40492 | 35386 |
| PY6 | 4970 | 15689 | 30382 |
| PY7 | 3319 | 7681 | 42104 |
| PY8 | 5380 | 5981 | 43079 |

| Dollar equivalent of training person-hours delivered | | | | | | |
|---|---|---|---|---|---|---|
| | PY4 | PY5 | PY6 | PY7 | PY8 | Cost |
| **Webinar** (hours) | 7,984 | 2,479 | 4,970 | 3,319 | 5,380 | $9.98 |
| (dollar value) | $79,680 | $24,740 | $49,601 | $33,124 | $53,692 | |
| **Async** (hours) | 21,494 | 40,492 | 15,689 | 7,681 | 5,981 | $9.98 |
| (dollar value) | $214,510 | $404,110 | $156,576 | $76,656 | $59,690 | |
| **Live** (hours) | 22,364 | 35,386 | 30,382 | 42,104 | 43,079 | $11.29 |
| (dollar value) | $252,490 | $399,508 | $343,013 | $475,354 | $486,362 | |
| **Total** | $546,680.00 | $828,358.52 | $549,189.60 | $585,134.16 | $599,744.69 | |

Table 4-10 above provides details about costing and valuation of XSEDE training delivery for PY4 through PY8. Base costs for in-person classroom instruction, live webinars and asynchronous self-paced instruction are provided in tabs 12 and 13 of the study data set.

Valuation for resolving Help Desk tickets and total value of the Help Desk service is based on the number of tickets resolved per year multiplied by a standard dollar amount per ticket drawn from commercial estimates of help desk costs. Table 4-11 below contains this information. Sources of commercial estimates for help desk ticket costs can be found in tabs 12 and 13 of the study data set. Three

categories of help desk tickets were reported: external, or from end users; XSEDE, from inside the organization; and SP, from Service Providers.

Table 4-11. Helpdesk ticket valuation.

| | # External tickets | XSEDE | SP | Cost per ticket | Total |
|---|---|---|---|---|---|
| PY4 | 0 | 0 | 0 | $22.00 | 0 |
| PY5 | 8,733 | 4598 | 4135 | $22.00 | $101,156 |
| PY6 | 14,715 | 7216 | 7499 | $15.56 | $112,281 |
| PY7 | 15,377 | 8054 | 7323 | $15.56 | $125,320 |
| PY8 | 14,436 | 7717 | 6719 | $15.56 | $120,077 |

Cyberinfrastructure Resource Integration (CRI) valuation is shown in Table 4-12 below. The CRI group provides two services to campus research computing support groups and end-users: packaged system and user software that can be downloaded on demand from a repository; and in-person (also on campus) consulting with possible labor and software savings. Software distribution was valued per download at an estimated savings of 30 minutes of system administrator time multiplied by a labor cost from the Bureau of Labor Statistics. Campus visits were valued by the campus' estimate of time saved as a result of a visit and consultation multiplied by the same industry estimate of labor cost used for valuing software distribution. Each campus visited was also asked to estimate the annual value of software expenses avoided as a result of their CRI engagements.

Table 4-12. Cyberinfrastructure Resource Integration valuation

CRI Software Distribution

| | Download | Compensation Cost | $ per 30 minutes | Total |
|---|---|---|---|---|
| PY4 | 973 | $120,834 | $30.21 | $29,393 |
| PY5 | 1,072 | $126,750 | $31.69 | $33,969 |
| PY6 | 1,296 | $129,510 | $32.38 | $41,961 |
| PY7 | 1,478 | $130,605 | $32.65 | $48,259 |
| PY8 | 1,077 | $133,499 | $33.37 | $35,945 |

CRI Campus Visits - Totals

| | Person Days Savings | Compensation Cost | 1 day $ | Days Saved |
|---|---|---|---|---|
| PY4 | $9,667 | $120,834 | $483.34 | 20 |
| PY5 | $65,910 | $126,750 | $507.00 | 130 |
| PY6 | $20,722 | $129,510 | $518.04 | 40 |
| PY7 | $113,626 | $130,605 | $522.42 | 218 |
| PY8 | $68,351 | $133,499 | $534.00 | 128 |

| | Software Savings |
|---|---|
| PY4 | $30,000 |
| PY5 | $50,000 |

| | |
|---|---|
| PY6 | $100,000 |
| PY7 | $123,000 |
| PY8 | $123,000 |
| | |
| | Campus Visits Total |
| PY4 | $39,667 |
| PY5 | $115,910 |
| PY6 | $120,722 |
| PY7 | $236,626 |
| PY8 | $191,351 |

# 5 Conclusions

This ongoing study of Return on Investment – measured as $ROI_{proxy}$ - for XSEDE services continues to demonstrate two important observations: such an analysis is possible even though direct measures of return are not available; and that, using reasonable proxy measures, the XSEDE program's services provides value in excess of cost to the NSF to both end-user researchers and to research computing service providers. This study will continue in Program Years 9, 10, and 11 with further extensions and refinements added to the basic method adopted for longitudinal analysis.

The overall return on the NSF's investment in XSEDE to XSEDE's Service Provider organizations and end-users over the period between July 2014 and August 2019 is estimated to be $152,326,885, or 1.46 times the NSF's funding to XSEDE over that period. By way of comparison to general market segment investment categories, XSEDE's ROI over the study period is about twice the 2019 national average for the Service industry sector. [10]

The most critical aspect of the method used in this study is the selection of proxy measures for return that are appropriate for both the service in question and the users consuming it, and which can be cast as dollar amounts per unit of service delivered. To date the proxy measures used in this study are of the value of time saved by users when adopting XSEDE services. We are continually looking for new ways to extend this study and further determine the value XSEDE provides to the research community.

The authors wish to commend this approach to others interested in applying the methods described here to other problems, and welcome comments and inquiries about this work. This is a new, important, and evolving area and we welcome the assistance of those who can help us enhance our efforts.

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# 6 Appendix I - XSEDE SP ROI Assessment PY4-6 Data Collection Instrument

(PY4-5 version shown, all questions the same in PY6)

| Question 1: Basic information about the SP you represent | | |
|---|---|---|
| | PY4 (July 1, 2014- June 30, 2015) | PY5 (July 1, 2015- June 30, 2016) |
| Your SP Level (1, 2, or 3) | | |
| For how much of each PY were you an SP (or were you acting as an SP) in months | | |

| Question 2: Quantitative assessment of the value of XSEDE activities to your SP, expressed in terms of effort equivalents. Units are in FTEs (or percentages of FTEs) | | | Explanation of service areas | Question 3: Quantitative assessment of the value of XSEDE activities to your SP, expressed in terms of replacement cost. Units are dollars/year. PY5 only | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **A.** If XSEDE did not exist, would it be possible for you to provision this service from your SP? (Yes, No, Unsure, Not applicable) | **B.** If XSEDE did not exist, what would it cost your SP to replace this service? (PY5-6 only, in dollars/year) | **C.** If XSEDE did not exist, would your SP seek to replace the service provided? (Please indicate your selection by placing an "X" in the appropriate cell.) | | | | |
| | Value received from XSEDE, in terms of FTE effort that your SP would have to invest to replace the services received from XSEDE | | | | | Yes | Yes, but at a reduced level of investment | No, because the service is of low value | No, it would be impossible to obtain funding at our institution | Other (please explain) |
| Activity | PY4 (July 1, 2014- June 30 2015 | PY5 (July 1, 2015- June 30, 2016) | | | | | | | | |
| Allocations | | | Management of the XSEDE (XRAC) allocation process | | | | | | | |
| Account Management & Authentication Services | | | Management of accounts and accounting, login and authentication services for xsede.org and resources authenticated through XSEDE (To a first order approximation, SPs that use this service get | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | account information in AMIE packets | | | | | | | |
| 24 x 7 Operations | | | Nighttime and weekend phone and emergency operations | | | | | | | |
| Ticket Support | | | Handling of problems sent to help@xsede.org | | | | | | | |
| User Survey | | | Value derived from information your SP receives from XSEDE user surveys | | | | | | | |
| Leadership | | | Value derived from XSEDE leadership (e.g. value of XSEDE leaders advocating CI funding) | | | | | | | |
| Project Managers and Financial Functions | | | Value you derive from project management, financial management, use of risk registry, staff portion of wiki | | | | | | | |
| User Information Services, including XSEDE.org | | | Information services and online information in xsede.org | | | | | | | |
| Training & Education | | | Value to your SP of training and education resources created and/or offered by XSEDE | | | | | | | |
| Outreach | | | Value of XSEDE outreach activities to your SP | | | | | | | |
| Network | | | Value of XSEDE network and XSEDE network operations to your SP | | | | | | | |
| Systems Engineering and Deployment | | | Value of XSEDE software engineering, software development, and/or software deployment to your SP | | | | | | | |
| Parallel computing support, other forms of advanced support, consultation, and programming (e.g. value of ECSS services to your SP) | | | Value of XSEDE Extended Collaborative Support Services (ECSS) to your SP staff activities, or to the activities of users of your SP. (For example, if ECSS optimized code that runs on your system, or if ECSS staff created a gateway that runs on your system, | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | what would it have taken to have your own SP staff do the work?) | | | | | | | |

| Question 4: Qualitative Assessments of Value of XSEDE to your SP | On a 1 - 5 scale, where "1" is "not at all important," "3" is "neutral - neither important nor unimportant," and "5" is "very important", how beneficial are the following aspects of participation in XSEDE to your SP? (If you have no basis for evaluating, please enter "Not applicable" or "N/A". |
|---|---|
| Support for Federally funded resources offered to national community by your SP | |
| Opportunity to share technical information with other SPs | |
| Opportunity to receive technical information from XSEDE | |
| Software distributed by XSEDE | |
| Enhanced grant competitiveness because of the formal relationship with XSEDE | |
| Other: | |
| Other: | |
| Other: | |
| Other: | |
| Other: | |

| Question 5: OpenText Comments - What is helpful or unhelpful about XSEDE from the standpoint of your SP? What would you like XSEDE to do differently in the future? Or keep the same? |
|---|
| |

# 7 Appendix II - XSEDE $ROI_{proxy}$ Assessment PY7-8 Data Collection Instrument

# XSEDE Value Assessment - PY 8- Service Provider Value Assessment

## XSEDE Service Provider Value Assessment - PY8

You are invited to take part in a research study — the XSEDE Service Provider (SP) Value Assessment (Project Year 8) — conducted on behalf of the eXtreme Science and Engineering Discovery Environment (XSEDE) by the Indiana University Pervasive Technology Institute and administered by the Indiana University Center for Survey Research. This study is designed to assess the value SPs place on various services delivered by the XSEDE project in terms of FTE allocation, as well the potential costs to replace these services.

DESCRIPTION OF PARTICIPATION FOR PARTICIPANTS If you choose to participate, you will complete this online assessment, which should take approximately 10 minutes to complete.

RISKS AND BENEFITS OF PARTICIPATION There are no anticipated risks beyond what one may encounter in the course of daily life. You may benefit from feeling that you are contributing to improving the national cyberinfrastructure ecosystem used by scientists, engineers, and researchers.

CONFIDENTIALITY STATEMENT Efforts will be made to keep any personal information that you might inadvertently disclose confidential. We cannot guarantee absolute confidentiality. Your personal information may be disclosed if required by law. Your responses will not be associated with your name, contact information, or institution, and your identity will be held in confidence in reports in which the survey results may be published and/or databases in which results may be stored.

Organizations that may inspect and/or copy survey records for quality assurance and data analysis include groups such as the study investigator and his/her research associates, the Indiana University Institutional Review Board or its designees, the study sponsor, the National Science Foundation, and (as allowed by law) state or federal agencies, specifically the Office for Human Research Protections (OHRP).

CONTACTS FOR QUESTIONS OR PROBLEMS For questions about the study, contact Indiana University Pervasive Technology Institute Information Manager Julie Wernert at (812) 856-5517 or jwernert@iu.edu. For questions about your rights as a participant or to discuss problems, complaints, or concerns about a research study, to obtain information, or to offer input, please contact the IU Human Subjects Office at (812) 856-4242 or by email at irb@iu.edu.

VOLUNTARY NATURE OF STUDY Taking part in this study is voluntary and there is no compensation for participation. You may choose not to take part or may leave the survey at any time. Leaving the survey will not result in any penalty. Your decision whether or not to participate in this survey will not affect your current or future relations with XSEDE project, the Indiana University Pervasive Technology Institute, or the National Science Foundation. This study was

approved by the Indiana University Institutional Review Board on January 29, 2020. Please reference protocol #1802128188A002/Exempt when inquiring.

- ○ Continue to the survey (4)

---

During XSEDE Project Year 8 (September 1, 2018 - August 31, 2019) what was your institution's Service Provider (SP) level?

- ○ 1
- ○ 2
- ○ 3

For how much of PY8 was your institution an SP (or acting as an SP)? *Please express your response in months.*

_____

How many researchers does your SP support?

- ○ Less than 100 (1)
- ○ 101-250 (2)
- ○ 251-500 (3)
- ○ 501-1000 (4)
- ○ More than 1000 (5)

Display This Question:

If During XSEDE Project Year 8 (September 1, 2018 - August 31, 2019) what was your institution's Ser... = 3

*Before responding to questions asking for quantitative measures, please take a moment to share your thoughts about being a member of the L3 community.*

Display This Question:

If During XSEDE Project Year 8 (September 1, 2018 - August 31, 2019) what was your institution's Ser... = 3

Why did your institution become an L3 SP?

_____

_____

_____

Display This Question:

If During XSEDE Project Year 8 (September 1, 2018 - August 31, 2019) what was your institution's Ser... = 3

What benefits, resources, and/or support did you expect to receive from the XSEDE project and/or the SP community when your institution became an L3 SP?

_____

_____

_____

Display This Question:

If During XSEDE Project Year 8 (September 1, 2018 - August 31, 2019) what was your institution's Ser... = 3

What benefits did your institution actually receive when it became an L3 SP?

_____

_____

_____

Display This Question:

If During XSEDE Project Year 8 (September 1, 2018 - August 31, 2019) what was your institution's Ser... = 3

Were your expectations met?

_____

_____

_____

Display This Question:

If During XSEDE Project Year 8 (September 1, 2018 - August 31, 2019) what was your institution's Ser... = 3

What benefits, resources, and/or support would you like to receive that you are not already receiving?

_____

_____

_____

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*The next set of questions ask about the quantitative value of XSEDE activities to your SP. Please review the corresponding explanations of service areas before responding.*

Allocations

*Management of the XSEDE (XRAC) allocation process*

Account Management & Authentication Services

*Management of accounts and accounting, login and authentication services for xsede.org and resources authenticated through XSEDE (To a first order approximation, SPs that use this service get account information in AMIE packets)*

24 x 7 Operations
*Nighttime and weekend phone and emergency operations*

Ticket Support
*Handling of problems sent to help@xsede.org*

User Survey
*Value derived from information your SP receives from XSEDE user surveys*

Leadership
*Value derived from XSEDE leadership (e.g. value of XSEDE leaders advocating CI funding)*

Project Managers and Financial Functions
*Value you derive from project management, financial management, use of risk registry, staff portion of wiki*

User Information Services, including XSEDE.org
*Information services and online information in xsede.org*

Training & Education
*Value to your SP of training and education resources created and/or offered by XSEDE*

Outreach
*Value of XSEDE outreach activities to your SP*

Network
*Value of XSEDE network and XSEDE network operations to your SP*

Systems Engineering and Deployment
*Value of XSEDE software engineering, software development, and/or software deployment to your SP*

Parallel computing support, other forms of advanced support, consultation, and programming (e.g. value of Extended Collaborative Support Services (ECSS) support services to your SP)
*Value of XSEDE Extended Collaborative Support Services (ECSS) to your SP staff activities, or to the activities of users of your SP. (E.g., if ECSS optimized code that runs on your system, or if ECSS staff created a gateway that runs on your system, what would it have taken to have your own SP staff do the work?)*

Considering each of the following XSEDE-provided services, what value did your SP receive during Project Year 8 (September 1, 2018-August 31, 2019)? *Please express your response in terms of the FTE effort required for your SP to provide the service.*

| | Value received in terms of FTE effort |
|---|---|
| Allocations | |
| Account Management & Authentication Services | |
| 24 x 7 Operations | |
| Ticket Support | |
| User Survey | |
| Leadership | |
| Project Managers and Financial Functions | |
| User Information Services, including XSEDE.org | |
| Training & Education | |
| Outreach | |
| Network | |
| Systems Engineering and Deployment | |
| Parallel computing support, other forms of advanced support, consultation, and programming | |

If XSEDE did not exist, would it be possible to provision the following services from your SP?

| | Yes | No | Unsure | Not applicable |
|---|---|---|---|---|
| Allocations | ○ | ○ | ○ | ○ |
| Account Management & Authentication Services | ○ | ○ | ○ | ○ |
| 24 x 7 Operations | ○ | ○ | ○ | ○ |
| Ticket Support | ○ | ○ | ○ | ○ |
| User Survey | ○ | ○ | ○ | ○ |
| Leadership | ○ | ○ | ○ | ○ |
| Project Managers and Financial Functions | ○ | ○ | ○ | ○ |
| User Information Services, including XSEDE.org | ○ | ○ | ○ | ○ |
| Training & Education | ○ | ○ | ○ | ○ |
| Outreach | ○ | ○ | ○ | ○ |
| Network | ○ | ○ | ○ | ○ |
| Systems Engineering and Deployment | ○ | ○ | ○ | ○ |
| Parallel computing support, other forms of advanced support, consultation, and programming | ○ | ○ | ○ | ○ |

| | Yes | Yes, but at a reduced level of investment | No, because the service is of low value | No, it would be impossible to obtain funding at our institution | Other |
|---|---|---|---|---|---|
| Allocations | ○ | ○ | ○ | ○ | ○ |
| Account Management & Authentication Services | ○ | ○ | ○ | ○ | ○ |
| 24 x 7 Operations | ○ | ○ | ○ | ○ | ○ |
| Ticket Support | ○ | ○ | ○ | ○ | ○ |
| User Survey | ○ | ○ | ○ | ○ | ○ |
| Leadership | ○ | ○ | ○ | ○ | ○ |
| Project Managers and Financial Functions | ○ | ○ | ○ | ○ | ○ |
| User Information Services, including XSEDE.org | ○ | ○ | ○ | ○ | ○ |
| Training & Education | ○ | ○ | ○ | ○ | ○ |
| Outreach | ○ | ○ | ○ | ○ | ○ |
| Network | ○ | ○ | ○ | ○ | ○ |
| Systems Engineering and Deployment | ○ | ○ | ○ | ○ | ○ |
| Parallel computing support, other forms of advanced support, consultation, and programming | ○ | ○ | ○ | ○ | ○ |

If XSEDE did not exist, would your SP seek to replace the service provided?

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Display This Question:

If XSEDE did not exist, would your SP seek to replace the service provided? [ Other] (Count) >= 1

If you selected "Other" for any of the services above, please explain below.

_____

_____

_____

If XSEDE did not exist, what would it cost your SP to replace the following services? *Please express your response in dollars/year. If your SP would not seek to replace a service if it were note provided by XSEDE, please indicate so by entering "Would not replace" or "NA" in the appropriate spaces.*

| | Dollars per year (1) |
|---|---|
| Allocations | |
| Account Management & Authentication Services | |
| 24 x 7 Operations | |
| Ticket Support | |
| User Survey | |
| Leadership | |
| Project Managers and Financial Functions | |
| User Information Services, including XSEDE.org | |
| Training & Education | |
| Outreach | |
| Network | |
| Systems Engineering and Deployment | |
| Parallel computing support, other forms of advanced support, consultation, and programming | |

*The following question asks for qualitative assessments of the value of XSEDE services to your SP during XSEDE Project Year 8 (September 1, 2018-August 31, 2019).*

On a 1 - 5 scale, where "1" is "Not at all important," "3" is "Neutral - neither important nor unimportant," and "5" is "Very important", how beneficial are the following aspects of participation in XSEDE to your SP? (If you have no basis for evaluating, please select "Not applicable.")

| | Not at all important 1 | 2 | Neutral - neither important nor unimportant 3 | 4 | Very important 5 | Not applicable |
|---|---|---|---|---|---|---|
| Support for Federally funded resources offered to national community by your SP | ○ | ○ | ○ | ○ | ○ | ○ |
| Opportunity to share technical information with other SPs | ○ | ○ | ○ | ○ | ○ | ○ |
| Opportunity to receive technical information from XSEDE | ○ | ○ | ○ | ○ | ○ | ○ |
| Software distributed by XSEDE | ○ | ○ | ○ | ○ | ○ | ○ |
| Enhanced grant competitiveness because of the formal relationship with XSEDE | ○ | ○ | ○ | ○ | ○ | ○ |

Display This Question:

If During XSEDE Project Year 8 (September 1, 2018 - August 31, 2019) what was your institution's Ser... = 3

Having just responded to the previous questions about replacement costs and FTE percentages, are there other metrics that are more relevant in assessing the benefits derived by Level 3 Service Providers? (i.e., in simpler terms, what metrics should we really be asking about to better assess the value you see in being an L3 SP?)

_____

_____

_____

Please share any comments you have about the value your SP receives from the XSEDE project (e.g., what is helpful or unhelpful about XSEDE from the standpoint of your SP, what would you like XSEDE to do differently in the future, etc.)

_____

_____

_____

End of Block: Main

# 8 Appendix III – Instruction letter sent with the Service Provider survey for PY6

Dear SP Forum Representative,

In everything we do that is supported by federal funding, we must document the return on investment that accrues for the nation. This is true of any project, including XSEDE. So, as ROI lead, I am again requesting your help with another round of ROI analyses for XSEDE. The data requested are broken into five key questions:

- Q1: Basic information about the SP you represent
- Q2: Quantitative value (in FTEs) of XSEDE activities in PY6
  The data requested are in FTE-years, to the nearest 0.25 FTE. For example, if the value to your SP of a given activity was 0.25 FTE in PY6, you would enter 0.25. Values may be negative.
- Q3: Quantitative value (in replacement cost) of XSEDE activities in PY6
  Using the same categories as Q2, please estimate the replacement cost to your SP if XSEDE did not exist. In addition, please estimate what your SP would spend to procure these services. Finally, please indicate the priority your SP places on the listed activities by indicating the level investment that would be made to replace the activity should XSEDE not exist.
- Q4: Qualitative value of XSEDE activities in PY6
  SP Forum representatives are asked to rate the qualitative importance of various factors. Many of the items evaluated will be most relevant to Level 3 SPs. Noting this fact, your suggested additions are welcome.
- Q5: Free text comments
  All comments are welcome and, again, your comments will not be associated with your name or institution, and all will be anonymized or redacted as necessary.

So that your responses remain confidential, I have arranged for the IU Center for Survey Research to collect and compile data via the attached spreadsheet. I am asking that you return the completed spreadsheet to csr@indiana.edu by XXXXXX. All data will be shared in aggregated form and all comments will be anonymized. Please direct any questions about the survey to csr@indiana.edu.

Thanks in advance!

Sincerely,
--Craig
Craig Stewart, Ph.D.
ROI Lead, XSEDE

# 9 Appendix IV – Instruction letter sent with the Service Provider survey for PY4 and PY5

Dear SP Forum Representative,

In everything we do that is supported by federal funding, we must document the return on investment that accrues for the nation. This is true of any project, including XSEDE. A couple of years ago, the SP Forum helped XSEDE assess its value by assessing its value to each of the SPs. This data led to the paper, *XSEDE Value Added, Cost Avoidance, and Return on Investment*, presented at XSEDE '15 (http://dx.doi.org/10.1145.2792745.2792768.)

As ROI lead, I am again requesting your help with another round of ROI analyses for XSEDE. Per discussions with the SP Forum, the data requested are broken into five key questions:

Q1: Basic information about the SP you represent

Q2: Quantitative value (in FTEs) of XSEDE activities in PY4 and PY5
The data requested are in FTE-years, to the nearest 0.25 FTE. For example, if the value to your SP of a given activity was 0.25 FTE in PY4 and of no value in PY5, you would enter 0.25 and 0, respectively. Values may be negative. Some newer SPs may have data for only PY5; for others, the data might be similar for both years. The list of categories is less fine grained than in the previous ROI assessment, but categories of activities are combined to enable comparison with data collected previously.

Q3: Quantitative value (in replacement cost) of XSEDE activities in PY5
Using the same categories as Q2, please estimate the replacement cost to your SP if XSEDE did not exist. In addition, please estimate what your SP would spend to procure these services. Finally, please indicate the priority your SP places on the listed activities by indicating the level investment that would be made to replace the activity should XSEDE not exist. Data requested in Q3 is for PY5 only.

Q4: Qualitative value of XSEDE activities in PY5
SP Forum representatives are asked to rate the qualitative importance of various factors. Many of the items evaluated will be most relevant to Level 3 SPs. Noting this fact, your suggested additions are welcome.

Q5: Free text comments
All comments are welcome and, again, your comments will not be associated with your name or institution, and all will be anonymized or redacted as necessary.

So that your responses remain confidential, I have arranged for the IU Center for Survey Research to collect and compile data via the attached spreadsheet. I am asking that you return the completed spreadsheet to csr@indiana.edu by May 12, 2016. All data will be shared in aggregated form and all comments will be anonymized. Please direct any questions about the survey to csr@indiana.edu.

These results will appear in a paper similar to the one that was given at XSEDE15; however, this time we plan to take it to one of the various quality and assessment conferences.

Thanks in advance!

Sincerely,
--Craig
Craig Stewart
ROI Lead, XSEDE

# 10 Appendix V – Cost basis for XSEDE services used in this analysis

The value of various XSEDE services per Full Time Equivalent employee, as computed from investment expenses for Program Year 4 to 8.

Table 10-1. Salary and total cost to XSEDE for various staff categories, PY4-PY8

| PY4 (Jul14-Jun15) | | | | | |
|---|---|---|---|---|---|
| WBS Mapping | Services | FTEs per service | FTE Cost | Travel, workstation, etc. | Total cost |
| 1.3.4 | Allocations staff | 2.15 | $430,000.00 | $20,000.00 | $450,000.00 |
| 1.2.5 | Account management staff | 2.85 | $570,000.00 | $0.00 | $570,000.00 |
| 1.2.1, 1.2.2, 1.2.3, 1.2.6 | Operations staff and ticket support staff | 19.99 | $3,621,000.00 | $309,000.00 | $3,930,000.00 |
| 1.6.9 | User survey total cost (staff plus contract) | 1.31 | $261,000.00 | $50,000.00 | $311,000.00 |
| 1.1.1 (L1/L2s only), 1.1.4, 1.1.5 | XSEDE leadership - PI, Co-Pis | 6.66 | $1,332,000.00 | $140,000.00 | $1,472,000.00 |
| 1.1.1 (PMs & Bus Office) | Project management and financial management staff | 4.50 | $900,000.00 | $0.00 | $900,000.00 |
| 1.3.2 | Web site information | 6.36 | $1,272,000.00 | $0.00 | $1,272,000.00 |
| 1.3.1, 1.6.1, half 1.6.10 | Training staff | 6.51 | $1,302,525.00 | $122,531.00 | $1,425,056.00 |
| 1.3.3, 1.6.5-1.6.8, half 1.6.10 | Outreach staff | 9.53 | $1,907,125.00 | $348,750.00 | $2,255,875.00 |
| | Network staff (same as "Operations Staff") | | | | $0.00 |
| 1.2.4, 1.1.2, 1.1.3, 1.1.6 | XCI staff | 17.83 | $3,567,000.00 | $18,000.00 | $3,585,000.00 |
| 1.4.x, 1.5.x | ECSS staff | 35.71 | $7,142,000.00 | $250,000.00 | $7,392,000.00 |
| | Totals: | 113.40 | $22,304,650.00 | $1,258,281.00 | $23,562,931.00 |

| PY5 (Jul15-Aug16) | | | | | |
|---|---|---|---|---|---|
| WBS Mapping | Services | FTEs per service | FTE Cost | Travel, workstation, etc. | Total cost |
| 1.3.4 | Allocations staff | 2.15 | $430,000.00 | $20,000.00 | $450,000.00 |
| 1.2.5 | Account management staff | 2.85 | $570,000.00 | $0.00 | $570,000.00 |
| 1.2.1, 1.2.2, 1.2.3, 1.2.6 | Operations staff and ticket support staff | 18.40 | $3,679,000.00 | $309,000.00 | $3,988,000.00 |
| 1.6.9 | User survey total cost (staff plus contract) | 1.31 | $261,000.00 | $50,000.00 | $311,000.00 |
| 1.1.1 (L1/L2s only), 1.1.4, 1.1.5 | XSEDE leadership - PI, Co-PIs | 7.12 | $1,423,903.23 | $100,000.00 | $1,523,903.23 |

| | | | | | |
|---|---|---|---|---|---|
| 1.1.1 (PMs & Bus Office) | Project management and financial management staff | 4.81 | $962,096.77 | $0.00 | $962,096.77 |
| 1.3.2 | Web site information | 6.00 | $1,200,000.00 | $0.00 | $1,200,000.00 |
| 1.3.1, 1.6.1, 1.6.10 (half) | Training staff | 6.65 | $1,330,000.00 | $120,000.00 | $1,450,000.00 |
| 1.3.3, 1.6.5-1.6.8, 1.6.10 (half) | Outreach staff | 9.14 | $1,830,000.00 | $350,000.00 | $2,180,000.00 |
| | Network staff (same as "Operations Staff") | | | | $0.00 |
| 1.2.4, 1.1.2, 1.1.3, 1.1.6 | XCI staff | 15.26 | $3,051,000.00 | $18,000.00 | $3,069,000.00 |
| 1.4.x, 1.5.x | ECSS staff | 35.57 | $7,113,000.00 | $250,000.00 | $7,363,000.00 |
| | Totals: | 109.24 | $21,850,000.00 | $1,217,000.00 | $23,067,000.00 |

| PY6 (Sep16-Aug17) | | | | | | |
|---|---|---|---|---|---|---|
| WBS Mapping | Services | FTEs per service | FTE Cost | Travel, workstation, etc. | Total Cost | Total Cost per FTE |
| 2.5.2 | Allocations staff | 2.34 | $358,264.00 | $0.00 | $358,264.00 | $153,104.27 |
| 2.5.3 | Account management staff | 5.52 | $732,411.00 | $0.00 | $732,411.00 | $132,683.15 |
| 2.4.2-2.4.5 | Operations staff and ticket support staff | 14.59 | $2,879,329.00 | $0.00 | $2,879,329.00 | $197,349.49 |
| 2.6.5 (Eval) | User survey total cost (staff plus contract) | 3.00 | $237,717.00 | $0.00 | $237,717.00 | $79,239.00 |
| 2.x.1 (Mgmt.), 2.6.2, 2.6.5 (Strategy) | XSEDE leadership - PI, Co-Pis | 7.57 | $2,064,882.00 | $0.00 | $2,064,882.00 | $272,771.73 |
| 2.x.1 (PMs), 2.6.3, 2.6.4 | Project management and financial management staff | 6.10 | $1,481,524.00 | $0.00 | $1,481,524.00 | $242,872.79 |
| 2.1.5 | Web site information | 4.48 | $566,345.00 | $0.00 | $566,345.00 | $126,416.29 |
| 2.1.2 | Training staff | 8.38 | $1,261,600.00 | $0.00 | $1,261,600.00 | $150,548.93 |
| 2.1.3, 2.1.4, 2.1.6 | Outreach staff | 4.30 | $900,747.00 | $0.00 | $900,747.00 | $209,476.05 |
| | Network staff (same as "Operations Staff") | | | | | |
| 2.3.2-2.3.3 | XCI staff | 8.44 | $1,814,219.00 | $0.00 | $1,814,219.00 | $214,954.86 |
| 2.2.2-2.2.6 | ECSS staff | 26.51 | $5,988,584.00 | $0.00 | $5,988,584.00 | $225,899.06 |
| | Totals: | 91.23 | $18,285,622.00 | $0.00 | $18,285,622.00 | $2,005,315.61 |

| PY7 (Sep17-Aug18) | | | | | | |
|---|---|---|---|---|---|---|
| WBS Mapping | Service | FTEs per service | FTE Cost | Travel, workstation, etc. | Total cost | Total cost per FTE |
| 2.5.2 | Allocations staff | 2.34 | $381,458.00 | $0.00 | $381,458.00 | $163,016.24 |
| 2.5.3 | Account management staff | 5.27 | $981,934.00 | $0.00 | $981,934.00 | $186,325.24 |
| 2.4.2-2.4.5 | Operations staff and ticket support staff | 15.19 | $3,081,713.00 | $0.00 | $3,081,713.00 | $202,877.75 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2.6.5 (Eval) | User survey total cost (staff plus contract) | 3.18 | $380,006.00 | $0.00 | $380,006.00 | $119,498.74 |
| 2.x.1 (Mgmt.), 2.6.2, 2.6.5 (Strategy) | XSEDE leadership - PI, Co-Pis | 6.76 | $2,349,954.00 | $0.00 | $2,349,954.00 | $347,626.33 |
| 2.x.1 (PMs), 2.6.3, 2.6.4 | Project management and financial management staff | 6.17 | $1,361,737.00 | $0.00 | $1,361,737.00 | $220,702.92 |
| 2.1.5 | Web site information | 4.48 | $518,556.00 | $0.00 | $518,556.00 | $115,749.11 |
| 2.1.2 | Training staff | 8.37 | $1,237,253.00 | $0.00 | $1,237,253.00 | $147,819.95 |
| 2.1.3, 2.1.4, 2.1.6 | Outreach staff | 4.01 | $1,006,896.00 | $0.00 | $1,006,896.00 | $251,096.26 |
| | Network staff (duplicate of "Operations Staff") | | | | | |
| 2.3.2-2.3.3 | XCI staff | 9.23 | $1,862,341.00 | $0.00 | $1,862,341.00 | $201,770.42 |
| 2.2.2-2.2.6 | ECSS staff | 25.93 | $6,399,740.00 | $0.00 | $6,399,740.00 | $246,808.33 |
| | Totals: | 90.93 | $19,561,588.00 | $0.00 | $19,561,588.00 | $2,203,291.29 |

| PY8 (Sep18-Aug19) | | | | | | |
|---|---|---|---|---|---|---|
| WBS Mapping | Services | FTEs per service | FTE Cost | Travel, workstation, etc. | Total cost | Total cost per FTE |
| 2.5.2 | Allocations staff | 2.35 | $383,310.00 | $0.00 | $383,310.00 | $163,110.64 |
| 2.5.3 | Account management staff | 5.50 | $1,105,984.00 | $0.00 | $1,105,984.00 | $201,088.00 |
| 2.4.2-2.4.5 | Operations staff and ticket support staff | 14.51 | $3,309,954.00 | $0.00 | $3,309,954.00 | $228,115.37 |
| 2.6.5 (Eval) | User survey total cost (staff plus contract) | 3.23 | $376,145.00 | $0.00 | $376,145.00 | $116,453.56 |
| 2.x.1 (Mgmt.), 2.6.2, 2.6.5 (Strategy) | XSEDE leadership - PI, Co-Pis | 6.93 | $2,456,782.00 | $0.00 | $2,456,782.00 | $354,514.00 |
| 2.x.1 (PMs), 2.6.3, 2.6.4 | Project management and financial management staff | 5.98 | $1,197,749.00 | $0.00 | $1,197,749.00 | $200,292.47 |
| 2.1.5 | Web site information | 3.73 | $754,344.00 | $0.00 | $754,344.00 | $202,237.00 |
| 2.1.2 | Training staff | 9.00 | $1,519,990.00 | $0.00 | $1,519,990.00 | $168,887.78 |
| 2.1.3, 2.1.4, 2.1.6 | Outreach staff | 3.97 | $1,006,684.00 | $0.00 | $1,006,684.00 | $253,572.80 |
| | Network staff (same as "Operations Staff") | | | | | |
| 2.3.2-2.3.3 | XCI staff | 8.76 | $1,879,629.00 | $0.00 | $1,879,629.00 | $214,569.52 |
| 2.2.2-2.2.6 | ECSS staff | 27.11 | $6,003,127.00 | $0.00 | $6,003,127.00 | $221,435.89 |
| | Total: | 91.07 | $19,993,698.00 | $0.00 | $19,993,698.00 | $2,324,277.02 |

# 11 Appendix VI – Cost bases for computing Proxy for Return on XSEDE value to SPs, ECSS, Help Desk, Training and Cyberinfrastructure Integration

Table 11-1. Cost bases for return proxies

| **Cost basis for calculating --> Return Proxy** | XSEDE value to SPs | ECSS value to PIs (Reference: Computer and Information Research Scientist) | | CRI software distribution & campus visits (Reference: Network and Computer Systems Administrators) | | Helpdesk value | Training value | |
|---|---|---|---|---|---|---|---|---|
| **Program Year V** | | Salary (p.a.) | Benefits as percentage of salary | Salary (p.a.) | Benefits as percentage of salary | Cost per closed ticket | Live/In person (per person-hour) | Web based (per person-hour) |
| **PY4 Jul14-Jun15** | Used values from XSEDE budget (different value for each budget category). | $115,580 | 47% ($16.50/ $35.32) | $82,200 | 47% ($16.50/ $35.32) | $22.00 | $11.29 | $9.98 |
| **URL for reference** | | https://www.bls.gov/oes/special.requests/oesm15nat.zip | https://www.bls.gov/news.release/archives/ecec_03102016.htm | https://www.bls.gov/oes/special.requests/oesm15nat.zip | https://www.bls.gov/news.release/archives/ecec_03102016.htm | https://www.thinkhdi.com/~/media/HDICorp/Files/Library-Archive/Rumburg_SevenKPIs.pdf | https://www.pryor.com/training-seminars/microsoft-excel-basics/ | http://www.hrclassroom.com:80/content/lms-training-basic-pricing.aspx |
| **PY5 Jul15-Aug16** | Used values from XSEDE budget | $116,320 | 50% ($18.34/ $36.95) | $84,500 | 50% ($18.34/ $36.95) | Same as PY4 | Same as PY4 | Same as PY4 |
| **URL for reference** | | https://www.bls.gov/oes/2016/may/oes151111.htm | https://www.bls.gov/news.release/archives/ecec_03172017.htm | https://www.bls.gov/oes/2016/may/oes151142.htm | https://www.bls.gov/news.release/archives/ecec_03172017.htm | Same as PY4 | Same as PY4 | Same as PY4 |
| **PY6 Sep16-Aug17** | Used values from XSEDE expenses | $119,570 | 50% ($19.11/ $38.90) | $86,340 | 50% ($19.11/ $38.90) | $15.56 | Same as PY4 | Same as PY4 |
| **URL for reference** | | https://www.bls.gov/oes/2017/may/oes151111.htm | https://www.bls.gov/news.release/archives/ecec_03202018.htm | https://www.bls.gov/oes/2017/may/oes151142.htm | https://www.bls.gov/news.release/archives/ecec_03202018.htm | https://www.thinkhdi.com/library/supportworld/2017/metric-of-month-service-desk-cost-per-ticket.aspx | Same as PY4 | Same as PY4 |
| **PY7 Sep17-Aug18** | Used values from XSEDE expenses | $123,850 | 50% ($19.48/ $38.92) | $87,070 | 50% ($19.48/ $38.92) | Same as PY6 | Same as PY4 | Same as PY4 |
| **URL for reference** | | https://www.bls.gov/oes/2018/may/oes151111.htm | https://www.bls.gov/news.release/archives/ecec_03192019.htm | https://www.bls.gov/oes/2018/may/oes151142.htm | https://www.bls.gov/news.release/archives/ecec_03192019.htm | Same as PY6 | Same as PY4 | Same as PY4 |
| **PY8 Sep18-Aug19** | Used values from XSEDE expenses | $127,460 | 51% ($20.17/ $39.72) | $88,410 | 51% ($20.17/ $39.72) | Same as PY6 | Same as PY4 | Same as PY4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| URL for reference | | https://www.bls.gov/oes/current/oes151221.htm | https://www.bls.gov/news.release/archives/ecec_03192020.htm | https://www.bls.gov/oes/current/oes151244.htm | https://www.bls.gov/news.release/archives/ecec_03192020.htm | Same as PY6 | Same as PY4 | Same as PY4 |

# 12 Appendix VII – Costing details for return proxy measures.

Table 12-1. Costing details for proxy for return measures for ECSS and CRI labor and help desk ticket clearing costs

**Employer Compensation Cost - used for ECSS data (Computer and Information Research Scientist)**

| | 2019 | 2018 | 2017 | 2016 | 2015 | Source |
|---|---|---|---|---|---|---|
| Salary $ | $127,460 | $123,850 | $119,570 | $116,320 | $115,580 | https://www.bls.gov/oes/tables.htm |
| Benefits % | 51% | 50% | 50% | 50% | 47% | https://www.bls.gov/bls/news-release/ecec.htm |
| Benefits $ | $65,005 | $61,925 | $59,785 | $58,160 | $54,323 | |
| Total $ | $192,465 | $185,775 | $179,355 | $174,480 | $169,903 | |

**Employer Compensation Cost - used for CRI data (Network and Computer Systems Administrators)**

| | 2019 | 2018 | 2017 | 2016 | 2015 | Source |
|---|---|---|---|---|---|---|
| Salary $ | $88,410 | $87,070 | $86,340 | $84,500 | $82,200 | https://www.bls.gov/oes/tables.htm |
| Benefits % | 51% | 50% | 50% | 50% | 47% | https://www.bls.gov/bls/news-release/ecec.htm |
| Benefits $ | $45,089 | $43,535 | $43,170 | $42,250 | $38,634 | |
| Total $ | $133,499 | $130,605 | $129,510 | $126,750 | $120,834 | |

**Helpdesk Tickets Cost**

| | 2013 | 2016 | Source |
|---|---|---|---|
| MetricNet | $22.00 | | https://www.thinkhdi.com/~/media/HDICorp/Files/Library-Archive/Rumburg_SevenKPIs.pdf |
| MetricNet | | $15.56 | https://www.thinkhdi.com/library/supportworld/2017/metric-of-month-service-desk-cost-per-ticket.aspx |

**Training Cost sources**

*In person*

Courses offered in person by Pryor.com: Excel Basics, and Excel Beyond Basics. Both seem to be consistently the same price across years.

$79/7h = $11.29 Excel Basics --- $99/7h = $14.14 Beyond Basics

2008 - http://web.archive.org/web/20080821115207/http://www.pryor.com/mkt_info/seminars/desc/ey.asp $99 (Beyond Basics)

2013 - http://web.archive.org/web/20130522070849/http://www.pryor.com/mkt_info/seminars/desc/Y7.asp?zip=94107 $99 (Beyond Basics)

2016 - http://web.archive.org/web/20160318230032/http://www.pryor.com/mkt_info/seminars/desc/y7.asp?zip=94107 $99 (Beyond Basics)

2018 - https://web.archive.org/web/20181009102824/https://www.pryor.com/training-seminars/microsoft-excel-basics/ $79 (Excel Basics)

2018 - http://web.archive.org/web/20181130055244/http://www.pryor.com/training-seminars/microsoft-excel-beyond-basics/ $99 (Beyond Basics)

2020 - https://www.pryor.com/training-seminars/microsoft-excel-beyond-basics/ $99 (Beyond Basics)

2020 - https://www.pryor.com/training-seminars/microsoft-excel-basics/ $79 (Excel Basics)

*Web*

HR website that sells units for $9.98. The unit seems to translate to 1h, but the price goes down if your buy a bigger package with more units.

2014 - https://web.archive.org/web/20140127162853/http://www.hrclassroom.com:80/content/lms-training-basic-pricing.aspx

2015 - https://web.archive.org/web/20150218063400/http://www.hrclassroom.com:80/content/lms-training-basic-pricing.aspx

2020 - http://www.hrclassroom.com:80/content/lms-training-basic-pricing.aspx

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