Project: Personal Tutoring Service (PTS)

CSE 5325 – Fall 2023

Project Management

Module: COCOMO

Deliverable: COCOMO Estimate Report

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1. Introduction

A Personal Tutoring Service (PTS) project represents a transformative solution to address the educational needs of individuals seeking personalized academic guidance. Our team has been tasked with developing a web application and a mobile application for Android that will revolutionize the way people access and benefit from tutoring services. Our client has outlined specific functionalities they desire for the software, and we have been granted a three-month timeline for project completion. As the project manager, I initially aligned with our client's timeline expectations; however, a detailed COCOMO analysis has revealed that adhering to this schedule is not feasible. This project raises the intricate challenge of resource estimation, a common concern in large software development projects, where cost and time estimation are of paramount importance.

The primary objective of this document is to determine the time and cost requirements for the development of the PTS system using the Constructive Cost Model (COCOMO II). We will explore what adjustments can be made to meet the three-month deadline while maintaining project quality and efficiency. Our development methodology for this project is the Waterfall model. Throughout this document, we will provide insights into the factors that influence project duration and the adjustments needed for project optimization. COCOMO II's effort and time equations serve as our guiding metrics, considering factors such as Effort Adjustment Factor (EAF) and Schedule Equation Exponent (SE).

This document will comprehensively address the factors influencing project duration and cost, along with associated assumptions. It will highlight areas for correction and optimization, which will be discussed with the stakeholders. Despite the initial challenges in the schedule, our team remains committed to the project's successful completion. We anticipate possible adjustments such as involving additional developers and outsourcing specific tasks to expedite the project timeline while ensuring the highest quality standards are met.

By reading this document, stakeholders and team members will gain an understanding of the complexities surrounding resource estimation and the identified problems within the initial schedule. Additionally, it will provide recommendations and insights on how to overcome these challenges to ensure a successful PTS project outcome. This document is a critical tool for navigating the complexities of large-scale software development and achieving the project's objectives.

2. Estimating Factors

2.1 Source of Lines of Code

The following is the number of lines of code delivered as part of this project, A justification for the total amount of LOC is provided.

SLOC | Source Lines of Code	Value Chosen: 5000
Justification: This decision stems from a meticulous evaluation of the project's scope and complexity. Our team envisions a comprehensive solution comprising both a web application and an Android mobile application. Despite the inclination towards considering a higher SLOC, the constraints posed by the systemstar's demo version and the need for streamlined functionalities led us to opt for 5000 SLOC. The choice of 5000 SLOC reflects a balance between project intricacy and efficiency. The PTS project, while intricate in its objectives, benefits from a strategic approach to code development. By carefully planning reusable logic and optimizing code efficiency, we anticipate meeting the project's requirements within the chosen SLOC. This decision is guided by a commitment to delivering a robust and functional tutoring service while ensuring optimal resource utilization.	

2.2 Scale Drivers

The following is the list of scale drivers, the values applicable to this project and a justification for each value chosen:

PREC | Precendentedness	Value Chosen: High
Justification: While personal tutoring services may not be entirely new, the specific features and requirements for this project, like profit management, app monitoring, and advertising, could be unique. The team might need to adapt to the nuances of educational software development.	

FLEX | Development Flexibility	Value Chosen: Low
Justification: The project has specific functionalities and tight deadlines that require adherence. Flexibility is limited to avoid compromising on these key aspects. While minor adjustments may be considered, major deviations from the project plan are discouraged to ensure the project stays on track and meets its objectives within the defined constraints.	

RESL | Risk Resolution	Value Chosen: Very High (80%)
Justification: Risks associated with the project have been thoroughly assessed, and a well-defined development architecture is in place. While some risks have been mitigated, there is recognition that unexpected challenges may arise during the development process, and plans are in place to address them promptly.	

TEAM | Team Cohesion	Value Chosen: Extra High (Seamless Interaction)
Justification: The team exhibits an unparalleled level of cohesion, ensuring seamless interaction among all stakeholders, programmers, and maintainers. The shared vision is deeply understood, fostering a harmonious working environment. Any potential disagreements are swiftly and effectively addressed, allowing the team to maintain a high level of collaboration and synergy throughout the project lifecycle.	

PMAT | Process Maturity	Value Chosen: SEI CMM Level 3-Defined
Justification: The team has a well-established understanding of software development processes. Roles and responsibilities are defined, and there is a shared understanding of the development process. While not at the highest maturity level, the team operates within a structured framework that ensures efficient project management.	

2.3 COST DRIVERS

The following is the list of cost drivers, the values applicable to this project and a justification for each value chosen:

ACAP | Analyst Capability	Value Chosen: High 70th Percentile – Above average
Justification: Given the complexity and specialized nature of the Personal Tutoring Service (PTS) project, our team possesses above-average capabilities in understanding educational requirements and designing effective tutoring solutions.	

APEX | Application Experience Cost Driver	Value Chosen: High
Justification: Our team has extensive experience in developing these kinds of applications. With an average of 4 years of experience in similar projects, we have a deep understanding of the application domain, contributing to high morale and efficiency.	

PCAP | Programmer Capability Cost Driver	Value Chosen: High 75th Percentile – Above average
Justification: Programming skills play a vital role in creating an efficient and effective tutoring platform. The team is above average in terms of programming capabilities, ensuring the development of a robust and feature-rich application.	

PLEX | Platform Experience Cost Driver	Value Chosen: Low (<= 2 months)
Justification: While the team has experience in general software development, specific platforms like Android application development for tutoring services may be new. A lower value is chosen to account for the initial learning curve.	

LTEX | Language and Tool Experience	Value Chosen: High (3 years)
Justification: Our team members have over 3 years of experience in using the required programming languages and development tools. This high level of experience ensures efficiency and proficiency in implementing the project.	

PCON | Personnel Continuity Cost Driver	Value Chosen: Nominal (6% turnover per year)
Justification: Our team has a stable personnel continuity rate, with a turnover of about 6% per year. This nominal turnover reflects the project's manageable risks associated with team members' continuity.	

TOOL | Use of Software Tools Cost Driver	Value Chosen: Very High
Justification: The use of advanced software tools is essential for developing an effective tutoring platform. The team will employ mature tools integrated with efficient processes to streamline development.	

SITE | Multisite Development Cost Driver	Value Chosen: Extra High
Justification: Given the potential need for collaboration with educators, an extra high value is chosen to account for possible distributed development and coordination efforts.	

SCED | Development Schedule Cost Driver	Value Chosen: Low (85% of nominal schedule)
Justification: The PTS project demands careful planning and detailed development stages. The low development schedule cost driver accounts for potential adjustments needed to meet the management's schedule expectations while ensuring a realistic timeframe.	

TIME | Execution Time Constraint Cost Driver	Value Chosen: Nominal (<= 50% use of available execution time)
Justification: Execution time is not a strict constraint, providing flexibility for optimizing the solution. The chosen value allows for efficient development without compromising quality.	

STOR | Main Storage Constraint Cost Driver	Value Chosen: Nominal (<= 50% use of available storage)
Justification: Assuming nominal storage requirements unless specific information about data volumes is provided. This can be adjusted based on the actual data needs of the tutoring service and to manage the risk we have already make amends for 3 servers.	

PVOL | Platform Volatility Cost Driver	Value Chosen: Low
Justification: The platform for the PTS project is expected to be stable, with minimal changes in the underlying technology. The low platform volatility cost driver reflects the project's predictability and stability.	

RELY | Required Reliability Cost Driver	Value Chosen: Very High (Critical System)
Justification: Considering the critical nature of educational systems and the impact on students' learning, the required reliability for the PTS project is set to very high. This reflects the emphasis on delivering a robust and dependable tutoring service.	

DATA | Database Size Cost Driver	Value Chosen: Nominal
Justification: While specific database information may vary, a moderate rating is assumed to account for potential data storage needs. Further clarification with the client is recommended to finalize this value.	

CPLX | Product Complexity Cost Driver	Value Chosen: High
Justification: The PTS project involves complex educational algorithms and personalized tutoring solutions, contributing to high product complexity. This value reflects the intricate nature of the software being developed.	

RUSE | Required Reusability Cost Driver	Value Chosen: Very High
Justification: The PTS project emphasizes code reusability to streamline development processes. The chosen high reusability cost driver aligns with the strategy of leveraging existing code across product lines. We will develop the logic first for the web application and reuse it in the android application.	

DOCU | documentation Match to Life-cycle Needs	Value Chosen: Nominal
Justification: Aligning with the organization's preferred software process, the chosen level of documentation is deemed appropriate for the project's life cycle needs without unnecessary complications.	

3 Project Final Timeline and Cost Structure

Parameter	Value
Previous cost	$149,250
Previous work and Duration	3 Months (approximately 2344 hours)
New Schedule (COCOMO based)	7.1 months (28 weeks)
New estimated COST (Human Resources)	$175,100 for 5 developers and 1 project manager
NON-HUMAN resources (hardware, servers, databases, security software packages etc.)	$75,000
Total cost Before profit and overhead	$250,000
Overhead cost (50% mark-up)	$125,000
Profit	$375,000
Total Cost	$750,000

Assumptions in Calculations:

- We will maintain a team of 5 developers, each developer is expected to work 40 hours per week.
- Developers will be compensated at a rate of $5000 per month and the project manager will receive compensation of $10000 per month.
- Non-human resources will remain unchanged and will inherit all costs from a previous project 2.
- The overhead cost will be marked up by 50% and the profit margin will be maintained at 100%.
- Each developer will receive one week of vacation during this 3-month period.

If we proceed with the COCOMO estimation, the project is projected to take 7.1 months for completion, which is unsustainable for both stakeholders and the organization. To address this, we can employ strategic measures such as outsourcing less critical tasks to available individuals, not necessarily developers. For instance, outsourcing the entire phase of requirement gathering and product testing is an option. Additionally, introducing an extra developer for a month during the implementation phase and having only the manager present at stakeholder meetings can optimize time usage. I believe that by minimizing the project design and implementation phase, which typically accounts for over 50% of the time, we can potentially complete the project in 4 months. I have outlined two timelines below for comparison – one based on COCOMO estimation and the other reflecting my prediction of a 4-month completion. The timelines themselves serve as a basis for comparison.

Project Timeline: (COCOMO Based)

No.	Phase Timeline (RQ+PD+DD+CT+IT)	Start Date	End Date
1	Team meeting with client to understand goals and requirements gathering. Preparing Project Development Documentation and training.	09/05/2023	10/04/2023
2	Analysis of functionality development. Hardware buying and installation.	10/05/2023	10/20/2023
3	Project designing starts. Choosing APIs, platform, and servers. Project meeting with the client to finalize design.	10/21/2023	11/02/2023
4	Implementation of web application. Front-end development and Android application designing.	11/03/2023	11/30/2023
5	Code repository setup and optimization.	12/01/2023	12/06/2023
6	Implementation of functionalities like tutor registration, tutoring categories, and basic search functionality. Meeting with client for a live demo at 50% implementation.	12/07/2023	01/06/2024
7	Implementation of tutor authentication, being a tutor, and hire a tutor functionality. Enforcing changes based on client feedback.	01/07/2024	02/03/2024
8	Implementation of review and payment functionalities. Profit management setup.	02/04/2024	02/19/2024
9	App Monitoring setup for preventing illegal and unethical issues. Implementation of communication features. Location feature implementation. Internal and external advertisement setup.	02/20/2024	03/10/2024
10	Q&A testing and Integration.	03/11/2024	04/05/2024
11	Project Deployment. Employee and client satisfaction meeting (in-between).	04/06/2024	04/10/2024

Project Timeline: (fast-tracked completion of 4 months)

No.	Description	Start Date	End Date	Status
1.	Requirement gathering	09/05/2023	09/20/2023	Outsourced
2. i	Product and system Design	09/07/2023	09/20/2023	Regular development
ii	Buying Personal Computers, servers, and databases etc.	09/17/2023	09/20/2023	Outsourced
3. i	Analysis on functionality development.	09/21/2023	10/05/2023	Regular development
ii	Stakeholders' meet.	10/06/2023	10/06/2023	Regular development
4. i	Implementation of web application.	10/07/2023	11/07/2023	Regular development
ii	Reusable programming development	10/07/2023	11/07/2023	Regular development
5. i	Primary development of android App.	11/08/2023	11/30/2023	Regular development
ii	Integrating reusable code to application.	11/15/2023	11/30/2023	Regular development
6. i	Web app and android integration.	12/01/2023	12/17/2023	Regular development
ii	Stakeholders' meet to finalize changes.	12/18/2023	12/18/2023	Regular development
7. i	Unit and code testing	12/19/2023	01/01/2024	Outsourced
ii	Quality assurance	12/22/2023	01/04/2024	Regular development
8.	Deployment	01/05/2024	01/05/2024	Regular development

4. Conclusion and Recommendations

In summary, I'd like to emphasize factors that contradicted our initial assessment. Initially, we aimed for a harmonious collaboration with stakeholders, envisioning the completion of the Personal Tutoring Service (PTS) project within a three-month timeframe. However, stakeholder expectations expanded to include advanced functionalities such as new tutoring categories, Profit management, and App Monitoring. When we applied the COCOMO II estimation model for cost and duration, it became evident that our initial timeline was unrealistic. This realization prompted the need for reassessment and strategic planning.

COCOMO exposed a significant discrepancy in our estimation, revealing that the project we anticipated completing in three months would actually require 7.1 months. Such an extended timeline is financially unsustainable for our organization, as it would consume a substantial amount of both human and non-human resources. To address this, we explored potential solutions. In order to make the project viable, we proposed completing it within a maximum of four months. However, the rigid structure of the waterfall model posed challenges in introducing necessary adjustments.

My suggestion is to persist with the waterfall model but split the project into manageable segments, aiming to finish in four months. This approach entails sacrificing some functionalities, focusing solely on essential features. By prioritizing tasks and allocating resources efficiently, particularly in web development, we can enhance the quality of the end product. Recognizing our team's limited experience in Android development, we propose outsourcing certain tasks, such as requirement gathering, to alleviate the workload on our developers.

Alternatively, transitioning from the waterfall to an agile development model was considered. Agile would allow for shorter sprints and the completion of specific functionalities in a more condensed timeframe. However, this shift would necessitate expanding our team, disrupting our cost estimation once again. Consequently, we decided to forego the agile approach.

While the challenge of completing the project in four months seems formidable, concentrating on web development and a basic Android application with nominal features for initial release appears feasible. Subsequent releases can then introduce additional features incrementally. This phased approach allows us to gain insights into necessary inclusions, streamline alpha and beta testing, and align with real-world scenarios. Communication with stakeholders will remain comprehensive to uphold transparency throughout the development process.

Appendices

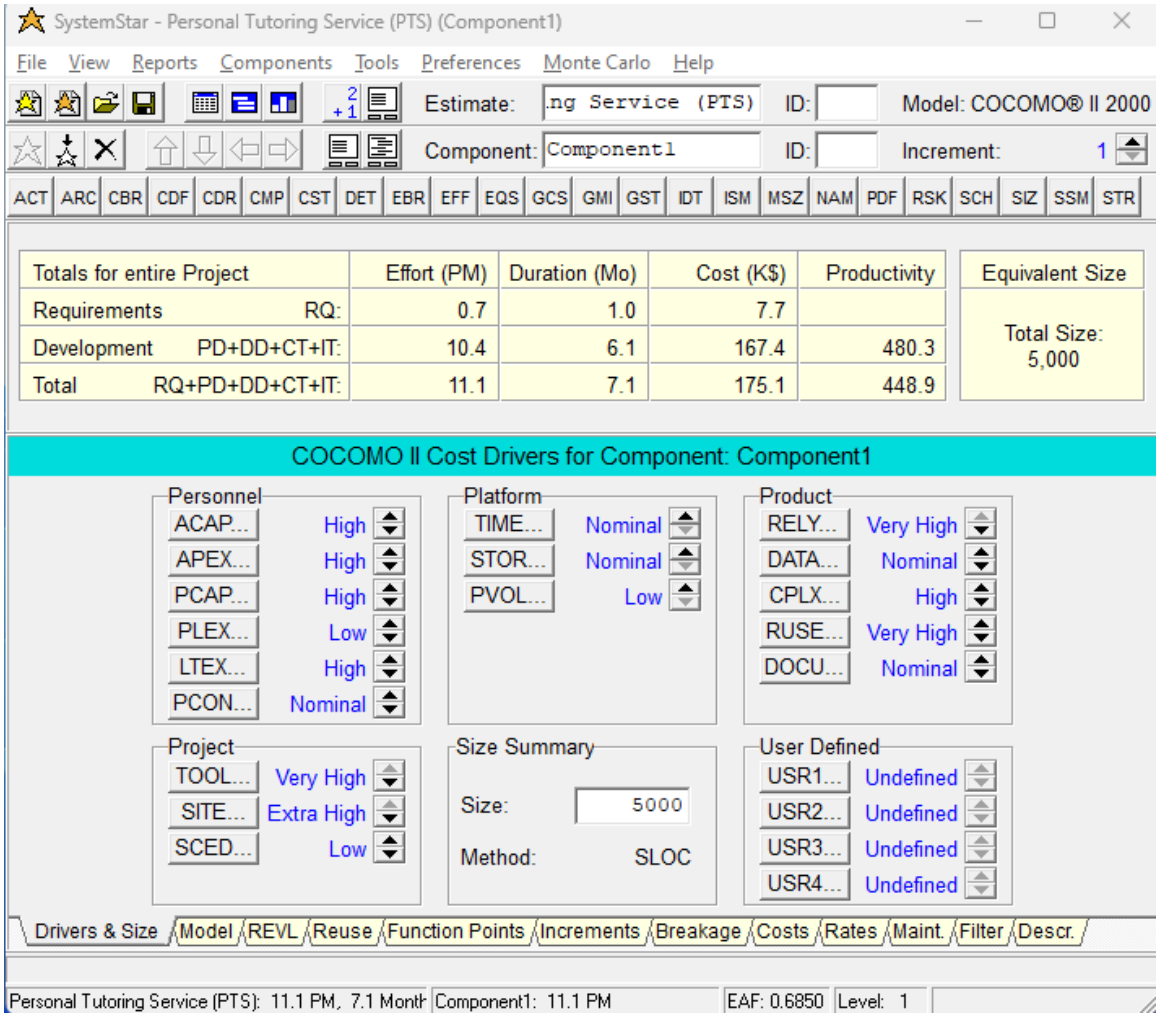
References:

https://www.pearsonhighered.com/assets/samplechapter/0/1/3/0/0130266922.pdf

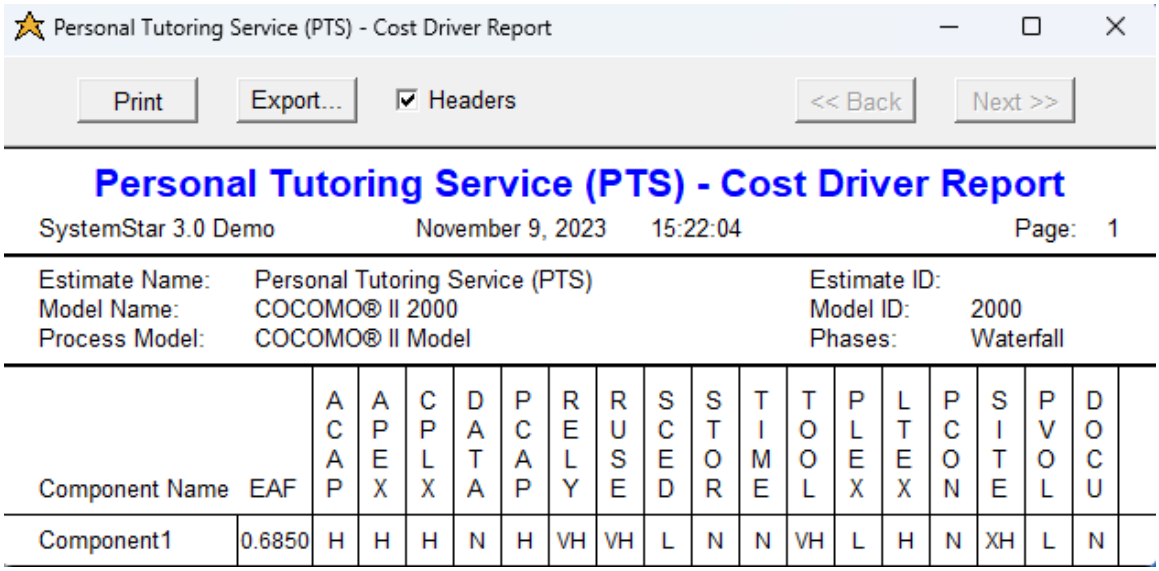
http://www.softstarsystems.com/overview.htm

COCOMO Print Screens:

1) Estimation Report

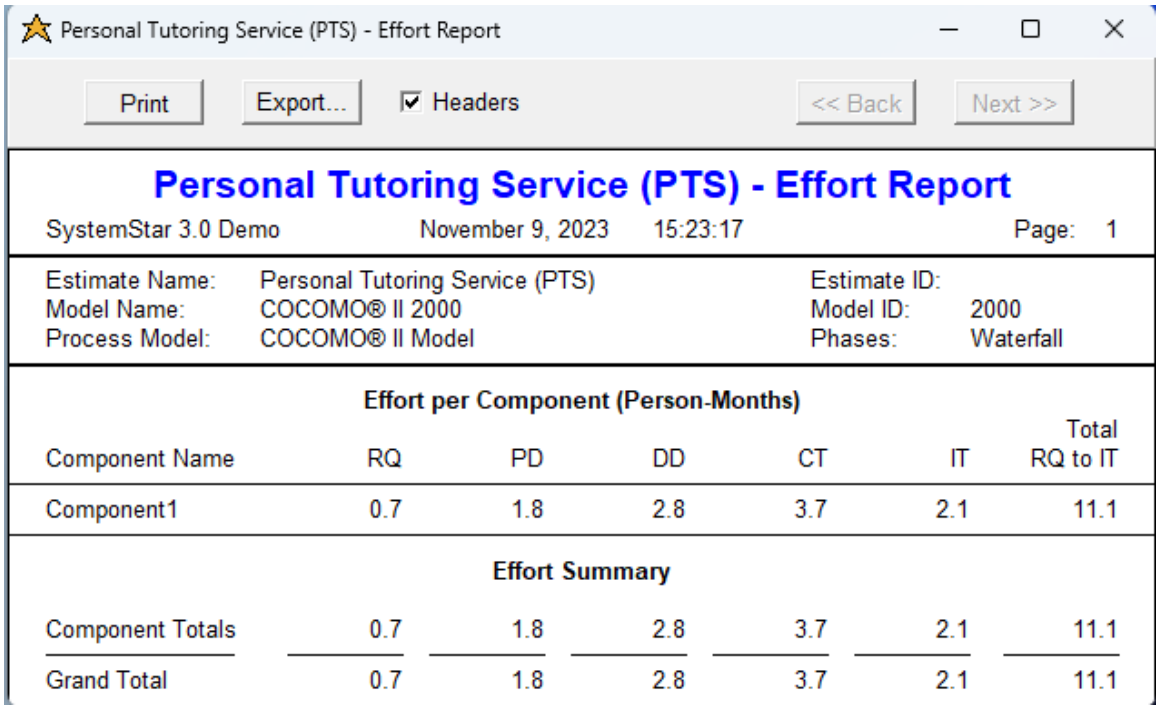


2) Cost Driver Report



Component Name	EAF	ACAP	APEX	CPLX	DATA	PCAP	RELY	RUSE	SCED	STOR	TIME	TOOL	PLEX	LTEX	PCON	SITE	PVOL	DOCU
Component1	0.6850	H	H	H	N	H	VH	VH	L	N	N	VH	L	H	N	XH	L	N

3) Effort Report



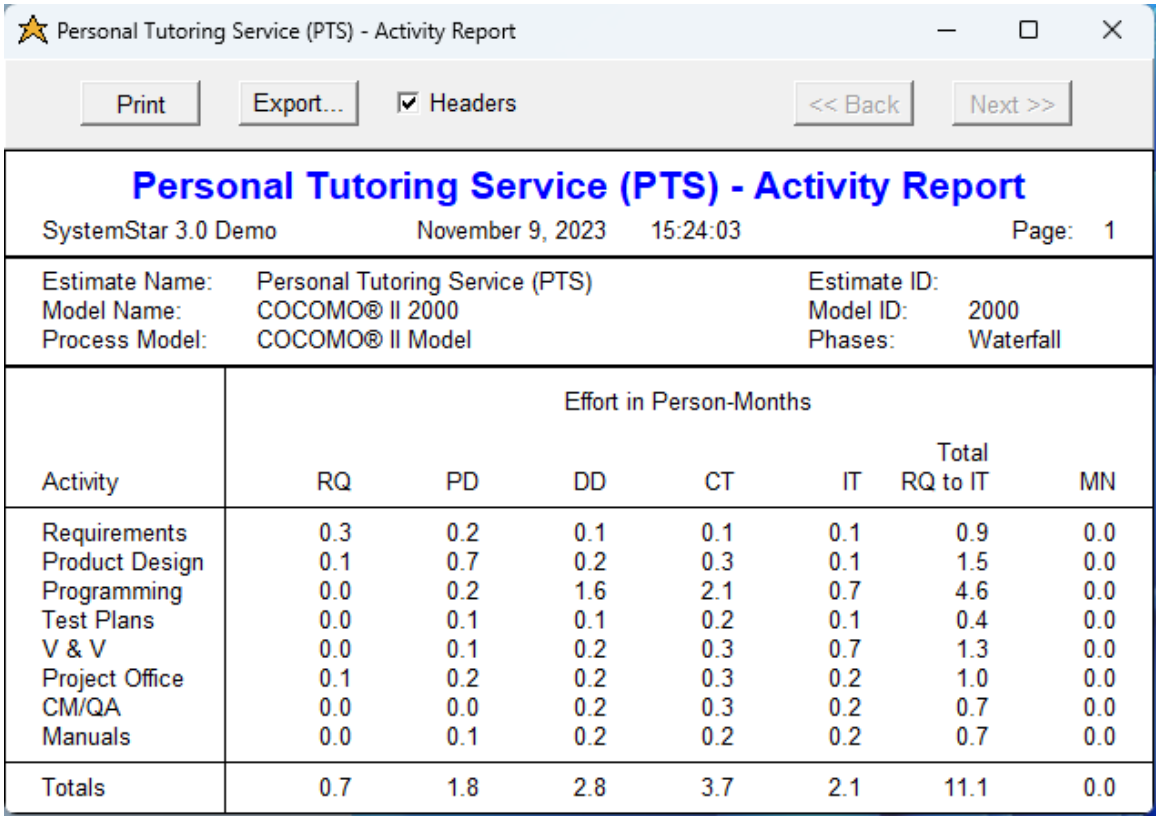
Effort per Component (Person-Months)

Component Name	RQ	PD	DD	CT	IT	Total RQ to IT
Component1	0.7	1.8	2.8	3.7	2.1	11.1

Effort Summary

Component Totals	0.7	1.8	2.8	3.7	2.1	11.1
Grand Total	0.7	1.8	2.8	3.7	2.1	11.1

4) Activity Report



Personal Tutoring Service (PTS) - Activity Report

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Personal Tutoring Service (PTS) - Activity Report

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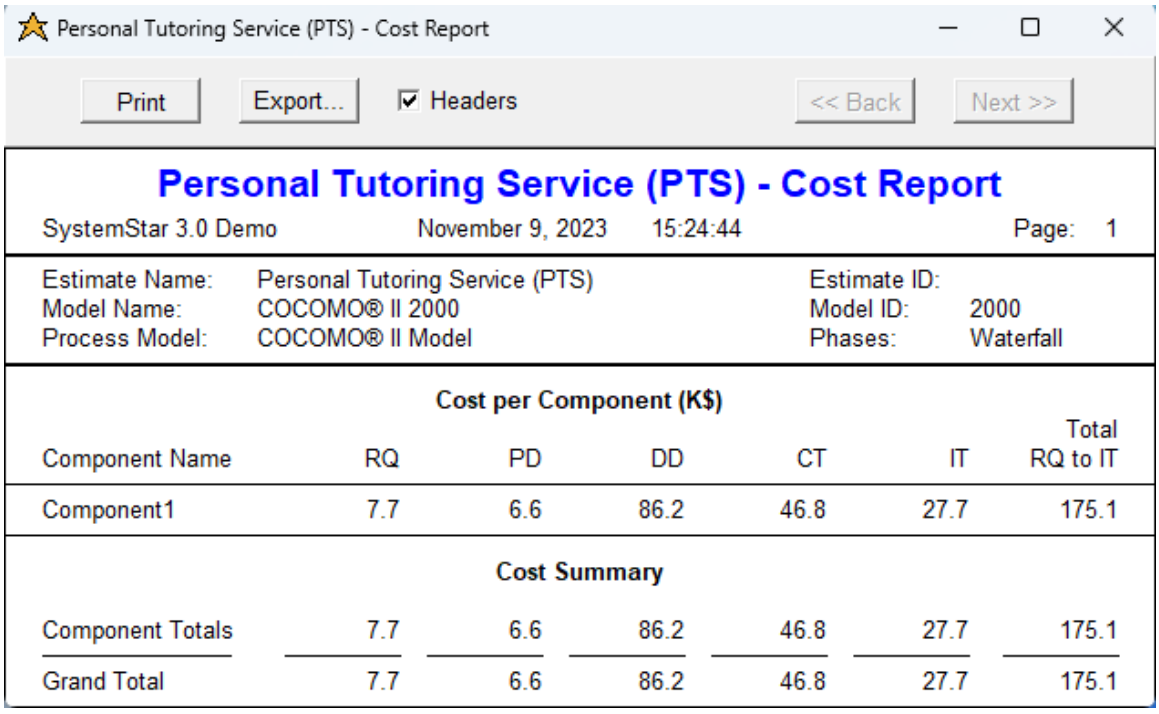
Estimate Name:	Personal Tutoring Service (PTS)	Estimate ID:	
Model Name:	COCOMO® II 2000	Model ID:	2000
Process Model:	COCOMO® II Model	Phases:	Waterfall

	Effort in Person-Months						
Activity	RQ	PD	DD	CT	IT	Total RQ to IT	MN
Requirements	0.3	0.2	0.1	0.1	0.1	0.9	0.0
Product Design	0.1	0.7	0.2	0.3	0.1	1.5	0.0
Programming	0.0	0.2	1.6	2.1	0.7	4.6	0.0
Test Plans	0.0	0.1	0.1	0.2	0.1	0.4	0.0
V & V	0.0	0.1	0.2	0.3	0.7	1.3	0.0
Project Office	0.1	0.2	0.2	0.3	0.2	1.0	0.0
CM/QA	0.0	0.0	0.2	0.3	0.2	0.7	0.0
Manuals	0.0	0.1	0.2	0.2	0.2	0.7	0.0
Totals	0.7	1.8	2.8	3.7	2.1	11.1	0.0

5) Cost Report



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Personal Tutoring Service (PTS) - Cost Report

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Estimate Name:	Personal Tutoring Service (PTS)	Estimate ID:	
Model Name:	COCOMO® II 2000	Model ID:	2000
Process Model:	COCOMO® II Model	Phases:	Waterfall

Cost per Component (K$)

Component Name	RQ	PD	DD	CT	IT	Total RQ to IT
Component1	7.7	6.6	86.2	46.8	27.7	175.1

Cost Summary

Component Totals	7.7	6.6	86.2	46.8	27.7	175.1
Grand Total	7.7	6.6	86.2	46.8	27.7	175.1

6) Costs for Component Report