

Triple P Enrollment System (TPES)

Informatics 43 Spring 2009
Official Requirements Specification

Introduction

This document describes the requirements for the Triple P Enrollment System (TPES), to be developed for the staff of the Central Counseling Office (CCO) at Pennsylvania Polytechnic University (Triple P), a small university in western Pennsylvania with approximately 800 students. Individual requirements in this document are marked with an identifier, such as **ES-1**, to make it easier to reference them throughout the documentation and implementation for the system.

TPES is intended to replace what is presently a manual, paper-based workflow for handling course scheduling and student enrollment university-wide. Triple P has recently received a large influx of money from private donors, has made a large land acquisition, and is commencing on a planned expansion. The paper-based workflow will not scale up to the significantly larger number of students planned in the future, so the university would like to undergo a staged automation of their course scheduling and student enrollment procedures. TPES is the first stage of that automation, in which the present workflow is automated as-is. Future stages of that automation will eliminate many of the manual aspects of the process, though these stages are mostly beyond the scope of this document and TPES.

User Requirements Definition

The primary goal of TPES is to enhance an existing workflow for course scheduling and student enrollment for the CCO. Before embarking on a description of the requirements of the system, it is important to consider the workflow that it is intended to replace.

Current Workflow

Triple P is a small university at present, so they are able to handle their needs more simply than larger universities. The CCO is in charge of campus-wide student counseling, course and classroom scheduling, and all student enrollment. All procedures related to scheduling and enrollment are currently managed on paper. This section describes the workflow presently used for managing scheduling and enrollment.

At the conclusion of each semester, planning for the next semester begins. The chair of each department contacts the CCO with a list of courses that need to be offered in the next semester, along with the maximum capacity of each course. This capacity is based primarily on instructor, teaching assistant, and grading support; courses for which fewer resources can be devoted will have smaller capacities.

The CCO compiles a list of all courses that need to be offered campus-wide and their capacities, then matches the courses to available classrooms. For each course, every attempt is made to ensure that its

classroom is large enough to accommodate the maximum capacity of the course; realistically, there are times in which the available classrooms are not large enough for some courses. Faculty have no input about meeting times; they are expected to be able to teach courses at any time from 7:00am-10:00pm on any weekday. No courses are ever scheduled on weekends.

Once courses have been scheduled into classrooms, students begin arriving for interim counseling meetings, which are required for all students before each semester. During each meeting, a counselor discusses a student's progress toward graduation, and helps the student to compile a list of preferred courses for the semester. These preference lists are collected as the meetings take place.

After all of the interim counseling meets are complete, the counseling staff begins scheduling students into courses manually, attempting to balance course capacities, classroom capacities, meeting times, and student preferences. Naturally, not all students are placed into their first-choice courses, but every attempt is made to provide the best set of student schedules possible. Students closer to graduation tend to be given their preferred courses before others.

At the conclusion of the process of scheduling students into courses, printed copies of students' schedules are available in the CCO; students come by and pick these schedules up in person. Once schedules are determined for each student, changes are not permitted; students are not permitted to add or drop courses during the semester.

Because of the manual nature of the current workflow, mistakes are made fairly often: students are enrolled in the wrong courses, too many students are enrolled in a course, courses are enrolled into classrooms that are too small, and so on. In the previous six semesters, 6% of courses were scheduled incorrectly and 9% of students had at least one mistake in their schedules.

What TPES Will Provide

TPES will assist in managing information about, and relationships between, three entities: (1) classrooms, (2) courses, which are scheduled into classrooms, and (3) students, who are enrolled into courses. Rules governing these relationships are implemented in TPES, so that, for example, students cannot be enrolled in courses that are full and two courses cannot be scheduled into the same classroom simultaneously. It is expected that TPES will dramatically reduce the number of mistakes made while scheduling courses and enrolling students.

Rather than providing the single view of the data that is available on paper, TPES allows multiple views of the same data (e.g., all courses scheduled in a classroom, all students enrolled in a course, all students who prefer a course, etc.). It is expected that this flexible presentation will allow Triple P's manual enrollment process to scale up as the number of students increases.

TPES is intended to be self-contained; it is not expected to be integrated with any of Triple P's other software systems. CCO staff will be the only users of the system. So deployment of the system, ultimately, should be relatively seamless, so long as the workflow of scheduling and enrollment is preserved.

New Workflow (with TPES)

When TPES is first put into place, CCO staff will enter information about all of the classrooms at Triple P into the system. Whenever new classrooms become available or existing classrooms become unavailable (e.g., for renovation), this information will be updated in the system.

Once TPES is in place, planning for a new semester will begin, still, with department chairs sending the same information about courses that they sent previously. This information will then be input into the system by CCO staff.

CCO staff will then proceed to schedule courses into classrooms, using TPES to assist in selecting appropriate classrooms and ensure that rules are being followed (e.g., no two courses scheduled simultaneously into the same classroom).

Students will begin arriving for their interim counseling meetings, during which their course preferences for the upcoming semester will be discussed. These preferences will then be entered into TPES by CCO staff. Students who are entering their first semester are added to the system at this time.

Once all interim counseling meetings have taken place, CCO staff will use TPES to schedule students into courses, using the information about student preferences, courses, and classrooms entered previously. TPES will ensure that rules related to student enrollment are followed.

Finally, TPES will generate a schedule for each student, which can then be sent to a printer; TPES will not, itself, support printing.

After each semester concludes, course and student enrollment information is removed from the system. Also, information about graduating students is removed the system. Classroom and student information remains between semesters.

System Requirements Specification

TPES must meet the following functional requirements.

Classrooms (CL)

CL-1. The following identifying information is stored about each classroom in the system:

- A unique name (e.g., “ICS 174” or “Triple P Lecture Hall”), which must be non-empty
- Its capacity, which is the number of students that can be seated in the room before it is full; this number must be at least 1

CL-2. The user must be able to add a new classroom to the system by specifying its identifying information. (See **CL-1.**) Initially, a classroom has no courses scheduled in it.

CL-3. The user must be able to remove a classroom from the system. Any course meeting intervals (see **CS-1**) for the classroom are removed from the system, as well.

Courses (CO)

CO-1. The following identifying information is stored about each course in the system:

- An ID, a four-digit number, which is unique within the current semester
- A unique course name (e.g., “Software Engineering” or “Underwater Basket Weaving”), which must be non-empty
- A maximum capacity, which is the number of students that the course can support (on the basis of things like instructor, teaching assistant, and grader availability); note that this capacity is independent of the capacity of a classroom, and must be at least 1
- A minimum number of minutes per week that the course is intended to meet; this value must be at least 0 — zero-length courses are used for things like independent study

CO-2. The user must be able to add a new course to the system by specifying its identifying information. (See **CO-1.**) Initially, a course is not scheduled into any classrooms and has no students enrolled in it.

CO-3. The user must be able to remove a course from the system. Any students enrolled in the course at the time are removed from the course, but not from the system (see **ES-1** and **ES-2**). Any classrooms scheduled to be used by the course become available at the scheduled times (see **CS-1** and **CS-3**).

Scheduling Courses into Classrooms (CS)

CS-1. Courses are scheduled into classrooms for one or more meeting intervals per week. Meeting intervals are contiguous blocks of time on a particular day, such as “Monday 2:00-2:50pm” or “Wednesday 9:00am-1:00pm.” Each meeting interval is scheduled in exactly one classroom.

CS-2. When there are multiple meeting intervals for a course, they do not have to be on particular days or at the same time every day; it’s possible, for example, to schedule a course for “Monday 9:00-10:50am,” “Tuesday 4:00-5:15pm,” and “Friday 7:00-10:00am.”

CS-3. When there are multiple meeting intervals for a course, they do not have to be scheduled into the same classroom.

CS-4. When there are multiple meeting intervals for a course, two or more meeting intervals are not permitted to overlap. For example, meeting intervals on “Monday 3:00-4:00pm” and “Monday 3:30-4:30pm” are not permitted for the same course.

CS-5. A course is considered “fully scheduled” when it is scheduled for a number of minutes per week that is at least as many as the minimum indicated for that course. (See **CO-1.**) This rule implies that zero-length courses are always fully scheduled.

CS-6. A course is considered “partially scheduled” if it is scheduled for at least one meeting interval each week, but is not scheduled for at least the number of minutes per week that are indicated for that course. (See **CO-1.**)

CS-7. A course is considered “unscheduled” if it is scheduled for no meeting intervals each week.

CS-8. Course schedules are limited to the hours of 7am-10pm Monday through Friday. No courses may be scheduled on weekends, before 7am on any day, or after 10pm on any day.

CS-9. Any of a course's meeting intervals may be scheduled into a classroom whose capacity is smaller than the course's maximum capacity. (See **CL-1** and **CO-1**.)

CS-10. A course's "effective capacity" is the smallest of the following values: (1) the maximum capacity of the course (see **CO-1**), (2) the capacity of each classroom in which the course has a meeting interval scheduled (see **CL-1**, **CS-1**, and **CS-9**). If a course has no meeting intervals scheduled, its effective capacity is its maximum capacity.

CS-11. While scheduling courses into classrooms, it must be possible for the user to view any of the following information.

- All classrooms, including their names and capacities
- All times throughout the week for which a particular classroom has nothing scheduled; this provides the user a way to find available classrooms
- All currently scheduled meeting intervals for a course
- The effective capacity of a course and the maximum capacity of a course, given its currently scheduled meeting intervals; this provides the user with a way of seeing, at a glance, whether the chosen classrooms have reduced a course's capacity.

These do not necessarily need to be separate screens or reports, but the information does need to be available to user, since this information on which course scheduling decisions will be based.

CS-12. Two or more course meeting intervals — from the same course or different courses — are not permitted to be scheduled into the same classroom at the same time.

Students (ST)

ST-1. The following identifying information is stored about each student in the system:

- An ID, a seven-digit number, which is unique amongst all students currently enrolled; note that this ID is not generated automatically by TPES, but is instead given to each student by another Triple P software system
- A last name (e.g., "Thornton"), which must be non-empty
- A first/middle name (e.g., "Alexander W.", "Alex", or "Boo Bear"), which must be non-empty; note that the middle name is not required and, when specified, can be either an initial or a name

ST-2. The user must be able to add a new student into the system by specifying its identifying information. (See **ST-1**.) Initially, a student is not enrolled in any courses and has no preferences about course enrollment.

ST-3. The user must be able to remove a student from the system. When students are removed from the system, they are also removed from any course in which they are enrolled.

Student Preferences (SP)

SP-1. During interim counseling meetings, each student, aided by a counselor, develops a list of preferred courses. Each student should have an associated list of preferred courses in TPES. This list is to be strictly rank-ordered by preference (i.e., most preferred, second-most preferred, etc.). There are no ties (i.e., no two courses can have the same rank).

SP-2. It must be possible to add a new course to a student's list of preferred courses, in the appropriate place in the rank order.

SP-3. It must be possible to remove a course from a student's list of preferred courses, in the appropriate place in the rank order.

SP-4. It must be possible to change the rank ordering of a student's list of preferences at any time.

SP-5. Students can have any number of courses, including zero, on their preference lists.

Enrolling Students into Courses (ES)

ES-1. A student can be enrolled in a course.

ES-2. A student can be removed from a course.

ES-3. Students can be enrolled into courses regardless of their preferences; preferences, in TPES, are informational.

ES-4. The number of students enrolled in a course must not exceed the effective capacity of the course. (See **CS-10**.)

ES-5. A student cannot be enrolled in the same course more than once in a semester.

ES-6. A student cannot be enrolled in more than one course that have any overlapping meeting intervals (see **CS-1**, **CS-2**, and **CS-3**). For example, a student cannot enroll in a course with a "Monday 9:00-10:50am" meeting interval and another course with a "Monday 10:00-11:50am" meeting interval, since these intervals overlap.

ES-7. While enrolling students into courses, it must be possible for the user to view any of the following information.

- A list of all students enrolled in a course, ordered by ID
- A list of all courses, listing classrooms and meeting times, ordered by ID
- A list of course preferences for a particular student, in order of preference
- A list of students who prefer a particular course, ordered by ID

These do not necessarily need to be separate screens or reports, but the information does need to be available to user, since this information on which course scheduling decisions will be based.

Finishing a Semester (FS)

FS-1. At the conclusion of a semester, CCO staff will need to “clear out” all information related to the current semester. At such time, the following changes must be made to the information in TPES:

- All courses are removed, since the courses offered from one semester to the next are different
- All scheduled meeting intervals in classrooms are removed, though the classrooms remain unchanged
- All preferred courses for each student are removed, since a student’s preferences will change from one semester to the next
- All enrollments of students into courses are removed, since students enroll into different courses each semester

To be clear, the system is not required to “know” that a semester has ended, but it must provide a semester-ending “clear out” function to users, which automatically makes the changes described above.

Saving the Data (SD)

SD-1. TPES must be able to save all data about classrooms, courses, students, and their relationships into one or more files on a local disk. Because TPES is not intended to integrate with other systems used by the CCO or elsewhere at Triple P, there is no requirement about the format(s) of the file(s).

SD-2. It is not necessary to save data about previous semesters; only the current semester’s data needs to be saved.

Constraints and Non-Functional Requirements

Performance (PE)

PE-1. It must be possible to make any of the following modifications to the system’s data within no more than a half-second:

- Adding, removing, or updating a student
- Adding, removing, or updating a course
- Adding, removing, or updating a classroom
- Scheduling a course’s meeting interval into a classroom
- Canceling a course’s meeting interval in a classroom
- Enrolling a student into a course
- Dropping a student from a course

Operating Environment (OE)

OE-1. TPES is to be delivered as a desktop application with a graphical user interface (GUI).

Portability (PO)

PO-1. The CCO is considering the purchase of new workstations for its staff. At this time, a decision has not been made about what kind of workstations will be purchased or what operating system they will

run. For that reason, TPES must be “platform-independent,” meaning that it must run with few or no modifications on all popular desktop operating systems (i.e., Windows, Mac OS X, Linux).

Robustness (RO)

RO-1. If, while saving data, an error occurs, the previously-saved data must be preserved. Only after saving is successful should the previous version of the data be eliminated.

RO-2. Users should not be permitted to enter invalid data; when an attempt is made to enter invalid data, users should be prompted with an error message and offered the opportunity to fix it.

Usability (US)

US-1. TPES will dramatically reduce the number of mistakes made while scheduling courses and enrolling students, so that only 1% of courses are scheduled incorrectly and 1% of students have at least one mistake in their schedules.

Implementation Phases

TPES is to be implemented and delivered in four phases. At least the first phase will be ready for deployment on Friday, June 5, 2009 at 9:00pm. Time permitting, the second and third phases may be delivered on this same date. The fourth phase, whose requirements are not described in this document, is to be delayed until after the third phase has been deployed and used for at least one semester.

Implementation Phase 1

The first phase is required to include all requirements *except* the following:

- **CL-3, CO-3, CS-11, ES-3, ES-7, FS-1, OE-1, PE-1, RO-1, RO-2, SP-1, SP-2, SP-3, SP-4, SP-5, ST-3, US-1**

Note that the program implementing the requirements for Implementation Phase 1 will run on only one computer, and will save its data on a local disk on that computer. Note, also, that the requirement of a GUI is not included in this phase; for this phase, a prototype console-mode user interface is all that is required.

Implementation Phase 2

The second phase adds requirement **OE-1** to the list in Implementation Phase 1 and no others. In other words, the second phase requires a GUI to be implemented.

Implementation Phase 3

The third phase is required to include all of the requirements listed in this document.

Note that the program implementing the requirements for Implementation Phase 2 will run on only one computer, and will save its data on a local disk on that computer.

Implementation Phase 4

The fourth phase of the implementation, which is not detailed in this document, adds the ability for the system to run on many machines instead of just one. A centralized database will be used to store information so that it can be shared between many instances of the program running on different computers.

Future Directions and Expected Changes

Even after TPES is deployed, a substantial amount of the work involved in scheduling courses and enrolling students will be manual. It is expected that, as the number of students at Triple P continues to grow, it will become necessary to automate at least some of this process. Some of the features that are expected to be automated in the future include:

- Scheduling courses into classrooms will occur automatically, with CCO staff given the opportunity to make any adjustments that are necessary.
- Scheduling students on the basis of their course preferences will either be done automatically on the basis of student preferences, or students will enroll in courses themselves (e.g., using a web-based system) on a first-come-first-served basis.

There is also considerable pressure from faculty to be able to provide their input into the course scheduling process. In the future, it may be necessary to schedule courses on the basis of faculty preferences.

Acceptance Test Plan

(Not included.)

Glossary

CCO	The Central Counseling Office, which handles student counseling, as well as course scheduling and student enrollment
Effective capacity	The number of students permitted to enroll in a course, taking into account the course's maximum capacity, as well as the capacity of the classroom(s) in which the course is scheduled
GUI	Graphical user interface, which provides access to the system's functionality
Interim counseling meeting	A meeting in which a student meets with a CCO counselor to discuss course preferences for the upcoming semester
Meeting interval	A contiguous block of time during which a course is scheduled to meet; each course has zero or more scheduled meeting intervals
TPES	Triple P Enrollment System, the system described in this document
Triple P	Pennsylvania Polytechnic University, the customer on whose behalf TPES is being developed