

Scheduling and Timetables: Managing University's Resources

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1. EXECUTIVE SUMMARY

1.1. Background

All Universities have invested, and still invest, a great deal of resources in creating and maintaining state-of-the-art Information Systems devoted to Student Management. One area that has received so far limited attention by University CIO's is the planning and scheduling of all resources needed to the appropriate delivery of the core activity of all Universities, i.e. teaching lessons. This is certainly the situation in Italy, where all required planning is done in a fragmented way, manually, or through some kind of PC tools. Previous research shows that this is the case in many other Universities across Europe.

1.2. Alternatives

CINECA, a the leading Italian University Consortium, has tackled the problem, in cooperation with some Universities, and through its subsidiary, Kion. The result is a software application, now in use at several Universities which is supporting the resource scheduling process.

1.3. Conclusions

This application, called U-GOV UP (University Planner) is part of UGOV, a suite of seamless integrated applications, covering the main needs of Universities. The application's focus is on four fundamental entities (peoples, resources, events, calendars), which combined together provide the full management of lessons timetables, and can be easily extended to cover all other possible events. The overall cycle of managing University's resources can be subdivided in three main phases: planning, editing and monitoring. U-GOV UP provides a broad vision across the whole process trying to provide the following benefits: Single centralized procedure, Configurability and Flexibility, Management of approval process, External interfaces and automated notifications engine.

2. OVERALL VISION ON SCHEDULING AND TIMETABLES IN A UNIVERSITY CONTEXT

One of the problems strongly linked to the "course planning" task is planning the lesson timetable and the general organisation of the university resources. Once the modalities for providing teaching have been established, the planning activity ideally continues with a verification of the resources available to satisfy the new training needs. It is first necessary to verify the availability of teaching staff to cover the courses; this is followed by a check on the available structures (classrooms, laboratories, etc.) in order to organise the lessons in the best possible way, on the basis of the number of expected students and the scheduled duration of the lessons and courses.

This U-GOV module addresses precisely the need of the Faculties or the offices appointed to provide for didactic organisation, for a tool which can also deal with this second part of the planning work which is preliminary to the actual teaching. The U-GOV University Planner module [1] is included in teaching and students functional area, and it has already been integrated with the other U-GOV modules (such as Course planning)

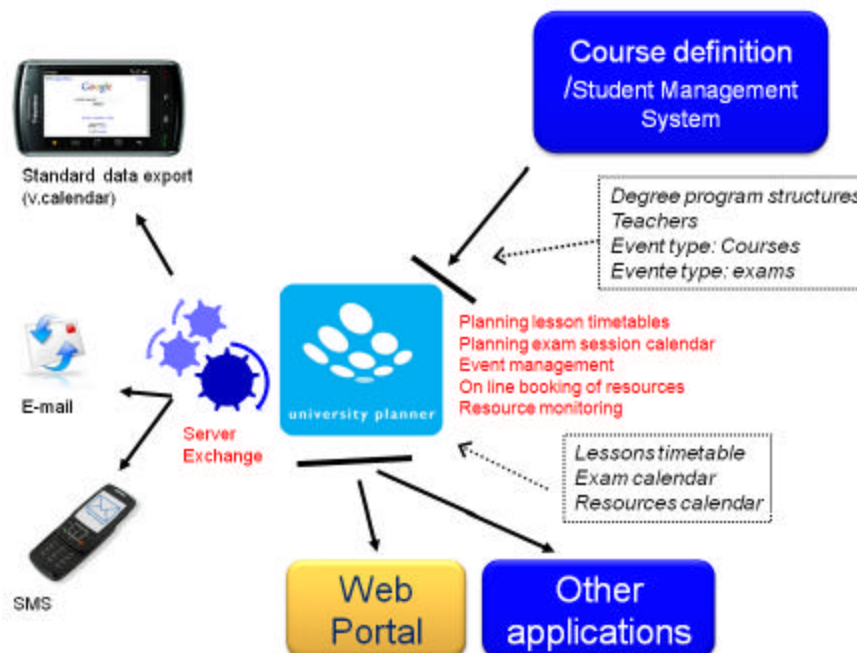


Figure 1. U-GOV University planner implementation scenario

In terms of functional domain, the University Planner application comes from the analysis of the requirements expressed by Italian universities which felt the need for managing the organisation of the calendar and the booking of the classrooms with an approach specifically conceived for universities. University Planner was therefore designed initially to manage the calendars and logics in the university context; it is obviously not limited exclusively to the didactic area, but allows for possible extension to all types of events that must be organised within the university and which may also come from other domains. In the U-GOV context, this complex task will be completely fulfilled by making the module a layer that is common to all possible applications that for various reasons govern activities that must be scheduled or which need a physical collocation.

The creation and classification of the events is designed to be "piloted" by other integrated applications. For example, the U-GOV *Course planning* provides the system with inputs relative to teaching with maximum detail of structures and features.

To offer maximum flexibility and extension of the didactic sphere to other departments, the system is modelled on four very abstract fundamental entities, within which other types of events can be classified (e.g. research programmes, university personnel training, etc) More specifically, University planner is based on:

- People
The system users (faculty planners, offices responsible for booking classrooms, etc.) and people seen as human resources (e.g. teaching staff) subject to planning.
- Resources
The physical structures of the university (classrooms, laboratories, etc.) or the equipment (projectors, PCs, overhead projectors, etc...)
- Events
All university activities that can be planned (courses, examinations, degrees, workshops, seminars, practical training, etc.) Each event can be broken down into its various elements, all of which can be planned in various ways.
- Calendars
Calendars are the only fundamental entity which can be associated with all the others. An event will have its calendar, i.e. a period of execution; a resource will have an opening calendar; a person will have a calendar of availability.

Each entity is connected to the others within the concept of "booking".

A "booking" is the request for a certain event at a certain moment (day and time) which involves one or more persons and one or more resources of various types. The booking is the main entity of the system.

On the basis of past experience in many universities, it was decided to opt for manual coherence check (entry of parameters) and not, therefore, based on an automatic calculation according to an algorithm (capable of calculating the best timetable configuration on the basis of a series of pre-established limits). This solution was adopted in order to cater for the universities' needs of flexibility and variability, which may not be possible with an automatic scheduling engine.

3. PLANNING, EDITING, MONITORING

The management cycle of the logistics of the university resources can be divided into three macro phases:

- Planning:
The first draft of the timetable (preliminary), including recurrent events (e.g. the timetable of the lessons), or a calendar of single dates (e.g. the examination timetable).
- Editing:
Once activities have started, the preliminary calendar may undergo variations over time, which can be communicated to the persons involved, and updates in real time the effective use of the resources.
- Monitoring:
The recording of the execution of the planned events and the real use of the resources. These recordings - normally registered on a sample basis - can then be the subject of statistical analyses, or used by the decision-making support system.

The three phases described above are examined in more detail below.

3.1. Planning

At first, the planning phase is based on the real data obtained from other modules of the U-GOV system. For example, all initial data (teaching, examinations, etc.) are available, complete with the attributes necessary for optimal organisation, and groups of similar elements are available in a flexible manner for planning. The input sources for the basic tables will in fact be:

- The common U-GOV databases of personal identities and university departments (organisation chart).
- The Course planning module as main input on events (lessons, practical training, examinations, etc.) as well as calendars (didactic periods, terms, sessions, etc...) and constraints deriving from the academic calendar (holidays, periods of suspension, etc...)

The planning concerns the various types of different events, for example "lesson" events or "examination" events. In this case the fundamental difference in approach depends on the fact that for a "lesson" event a recurring timetable must be created, while an "examination" event is more often a single activity lasting one day.

However, there are similar planning criteria common to both types. For example, mandatory lessons and examinations of a single course of studies in the same year of the course must not overlap.

Planning starts with the grouping of similar events that must be planned, and which it is convenient to keep together in this phase (groups of activities such as lessons for a certain degree course, those of the first year, those of the first term).

The operator can then enter the time slots that he/she wishes to use (e.g. 09.00-10.00, or blocks of hours, and indication of breaks). After that, he/she begins to position the events in the weekly chart, so that he/she can also visually check that events do not overlap.

In the planning phase, the congruence check can be activated periodically; this will point out any limits that have been exceeded, and the operator can then decide what changes to make.

After achieving a first satisfactory result, the system generates a proposed timetable for the teaching staff (transmitted by e-mail or inviting them to consult the timetable at the website).

Negotiations with the teaching staff will then follow in order to draw up the final timetable, which will then be circulated, covering all the hours foreseen for the specific timeframe.

The system also allows for timetables with complex timing: for example, lessons that begin after the start of the semester, weekly timetables (e.g. Thursday from 11.00 to 12.00 for the first 4 weeks, and Friday from 10.00 to 11.00 for the following week), or alternate weeks (e.g. Thursday from 11.00 to 12.00 for the first week, and Friday from 10.00 to 11.00 for the second week).

Once the complex timetable of lessons has been completed, the other events can be arranged in the hours that have remained free. Events management is synchronised in real time to also allow users other than the "planner" to book classrooms or to create events to be scheduled according to the availability of spaces and personal needs.

University Planner also manages single, or spot, events, which normally coincide with other different bookings on the calendar. This category includes events such as seminars, conferences, meetings of various kinds, presentations, and appointments.

The system also allows for planning events such as workshops and conference cycles which consist of several bookings over a certain period of time.

Parametri di Ricerca Risorse

Da Data* 22/05/2009 Da Ora 08:30 Durata* 04.00
 A Data* 29/05/2009 A Ora 21:30

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Risorse Necessarie: **logistica** | Ubicazione

Risorse Fisice:
 Facoltà: Scienze Matematiche, Fisiche e Naturali
 Tipo Risorse:
 Numero Posti:

Rete Proiettore
 Lavagna Luminosa Accesso Disabili
 Disponibilità PC

Numero Max Righe:

Includi l'utente connesso nel nuovo impegno

Risorse disponibili

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	Codice	Descrizione	Facoltà	Data Disp.	Durata Disp.	Da Ora	A Ora	Numero Posti
+	E000/A01	Sala circoscrizionale	Scienze Matematiche, Fisiche e Naturali	22/05/2009	13x00	08:30	21:30	180
-	E000/A01	Aula 101	Scienze Matematiche, Fisiche e Naturali	22/05/2009	13x00	08:30	21:30	25
-	E000/A010	Aula 204	Scienze Matematiche, Fisiche e Naturali	22/05/2009	13x00	08:30	21:30	50
-	E000/A011	Aula 205	Scienze Matematiche, Fisiche e Naturali	22/05/2009	13x00	08:30	21:30	50

Figure 2. The resources on-line booking function for spot events

3.2. Managing Event's variation

Once the general timetable for lessons, examinations and other types of activities has been planned and published, University Planner can be used for the management any variations.

When lessons have started and the planning phase has been completed, it becomes necessary to deal with timetable changes for many different reasons.

The editing of booking attributes (day, time, room, duration), which are considered variations, can be traced and notified after the date of the first publication of the timetable, thus giving users (students, teachers) immediate notice by publication on the website or by an e-mail message.

3.3. Monitoring the use of resources

To check on the real occupation of the resources and the efficiency of the timetable planning, it may be necessary to also introduce a system to monitor the effective execution of the planned activities and the number of participants attending the events.

For example, a lesson expected to be attended by 100 people will be correctly programmed in a room with this capacity, but attendance may in fact be more or less. In this case the lesson must be moved to a larger or smaller room, for an optimal logistic solution.

The system offers a special function for the "manual" monitoring of resources, normally carried out on a sample basis by appointed operators who enter the data on special forms at the website or on palmtop computers, or automatically through attendance badges. The recording may therefore regard the effective execution of the event/engagement and the number of participants. The resulting data can be collected in special reports for quality assurance and evaluation.

Monitoring the university structures is one of the key points often emphasised in the official documents of the CRUI (the Italian University Rectors' Conference), in the 7/07 document of the National Committee for the Assessment of the University System (see Italian Ministerial Decree 544),

and it also becomes an indispensable instrument for the wise management of the university infrastructures, often not exploited to their full potential.

4. U-GOV UNIVERSITY PLANNER: BENEFITS AND FEATURES

The experience gained in the field in recent years has shown that the system offers advantages when managing complex scenarios and circumstances.

An important aspect to be underlined is that University Planner deals with issues closely linked to other critical processes, such as "course planning". The integration of the planner with the other U-GOV modules thus becomes the first distinctive element of the system in respect of other solutions with similar purposes, which are not natively designed for the university context and which are limited to a specific organisation model (e.g. the faculty of engineering and not an arts faculty). The U-GOV module instead fits into the wider vision of university governance, overcoming the main organisational problems by means of:

- **A single, centralized procedure** shared by all offices.
The module offers a centralised procedure for the logistics management, common to all domains and sufficiently flexible to interface with the various organisational modalities in use.
- **Configuration and flexibility**
Commonly used standard profiles are in the default setting, but the system allows for maximum flexibility in the definition of users' profiles, with the possibility of indicating the functions enabled, data filters, event type filters, to then act on certain specific data. Specific selection parameters can also be entered for audit management, ranging from simple availability, temporal overlapping and compatibility of resources, to more complex circumstances.
- **Integration of data and applications**
The module was designed to integrate fully with U-GOV Course planning and to thus overcome situations of incongruence or inefficiency when teaching data is updated. As already underlined, the system takes the data about the main university structures (faculties, buildings, courses, departments, libraries) from the common U-GOV database and the data relative to most events to be planned (lessons, examinations, etc.) from the U-GOV module Course planning. This means that system operators do not have to re-enter into the system data already managed by other processes and which can be used for logistics planning.
- **Efficient use of resources**
Many university resources are very often under- or badly-utilized. Thanks to appropriate monitoring tools University Planner allows for significant improvement in the efficiency and quality of the management of the resources.
- **Management of the approval process**
The assignment of any resource (classrooms, laboratories, etc.) may require approval from the persons responsible for it. The assignment of responsibility is one of the more variable elements from one university to another. In some universities the Faculties are responsible for specific didactic structures, whereas in others they are only "users" of resources that are normally the responsibility of the Research Departments.

- **External interface and automatic notification engine**
U-GOV University Planner has a web services layer for effectively managing publication and all the system outputs in general. This facilitates integration with third applications such as web portals of public information systems. The web interface is designed for use both on classic workstations (PC, notebook) and with palmtops or mobile phones. The system is integrated with Outlook Exchange and can export the timetables into “ics” and “vcs” formats. There is also an internal engine for automatic multi-channel alert system (e-mail, sms) such as, for example, changes in lesson times, suspensions, cancellation of examinations, etc.
- **Usability**
The interface is designed for the main management functions of the back-office users and is flexible, and allows for the simultaneous management of classrooms, events and personal agendas. The application is also suitable for use in multi-monitor mode, for optimum visualisation of large quantities of data. Operating on the calendars is also made effective by the use of the many visualisation modes which are also used by the most common scheduling programs (e.g. Outlook).

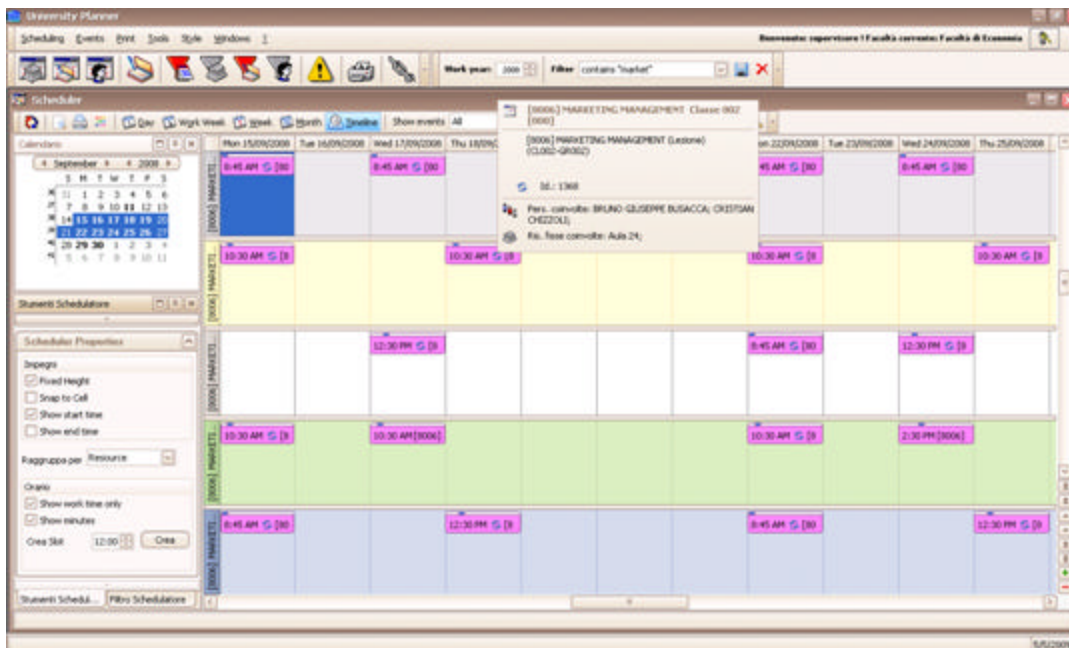


Figure 3. The planner timetable interface

5. REFERENCES

[1] U-GOV offers complete management of the main functional areas of the university. It consolidates and enlarges coverage of the areas already supported by CINECA applications, such as Accounting, Students & Learning and Human Resources and extends the field of action by proposing solutions in new strategic areas, for example research. The system is structured in *modules*, grouped in *functional areas* on the basis of the university administrative area to which they refer. These are:

- Planning and Controlling
- Accounting
- Human Resources
- Students and Learning
- Research