Costruzione dell'Orario delle Lezioni

Monitoring the timetable problem

DEFININIG A KPI MAP

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The timetable problem

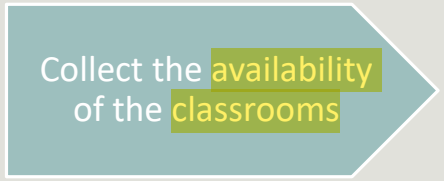
Every year the University of Bologna faces the problem of defining the timetable for each degree course

orario delle lezioni

- *How do you imagine the process for defining the timetable?* Qual'è il flusso delle attività per creare l'orario delle lezioni?
- *Which agents are involved?* Quali soggetti sono coinvolti?
- *How can we measure the goodness of the timetable?* Dopo aver capito com'é fatto il processo, come misurare la bontà dell'orario delle lezioni?

How do you imagine the process for defining the timetable?

Disponibilità delle Classi



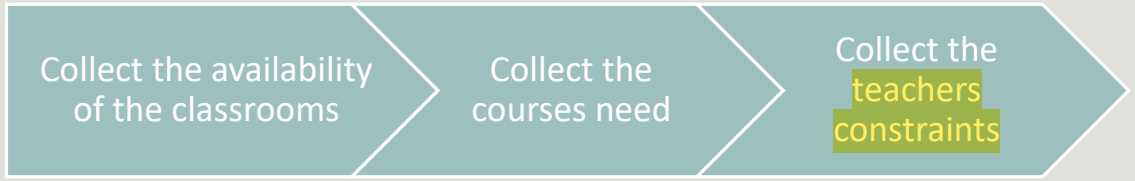
- *Classrooms are shared with other degrees*
- *The number of courses could change*

How do you imagine the process for defining the timetable?

Numero di studenti del corso

- *The number of hours per course could change*
- *The number of students could change*

How do you imagine the process for defining the timetable?



Chi sono i docenti?
Quali sono i loro vincoli?

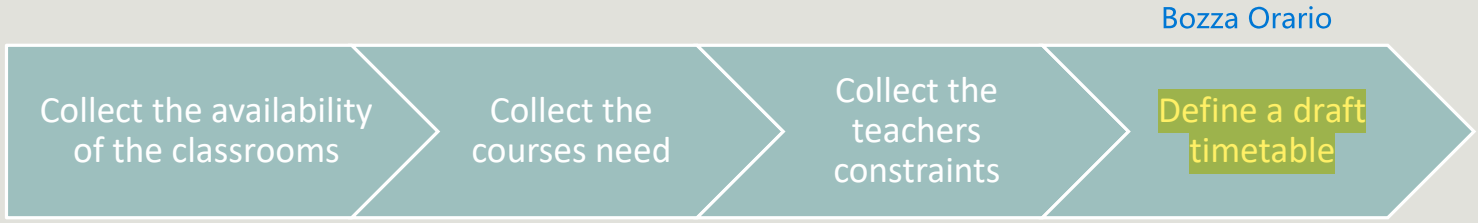
Due cosi, con stesso docente, non possono sovrapporsi

- *Teachers express hard constraints (e.g. on Monday I am already teaching at …)*

Preferenze del Docente

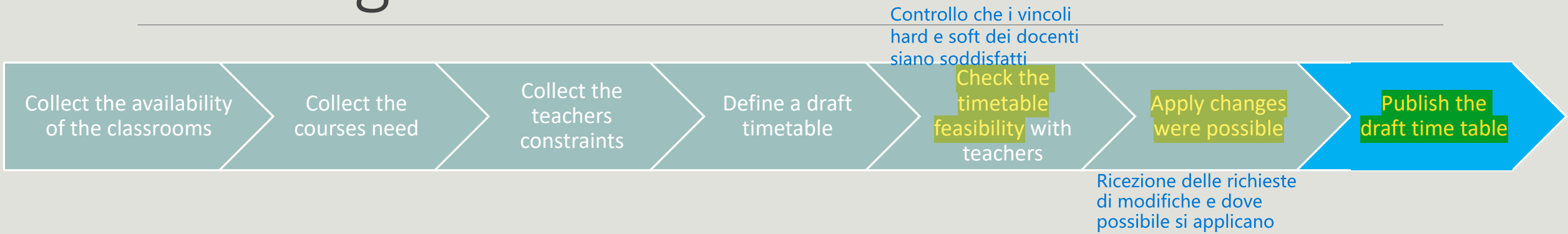
- *Teachers express soft constraints (e.g. I prefer 3 hours on Monday morning and 2 on Tuesday afternoon)*

How do you imagine the process for defining the timetable?



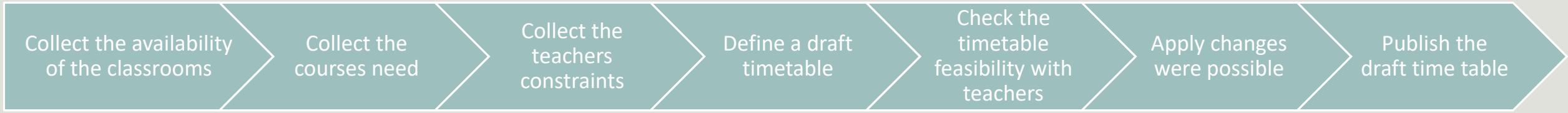
- *Timetable must be compliant with resources and constraints (at least hard ones)*

How do you imagine the process for defining the timetable?



- *In practice many iterations and adjustments are required*

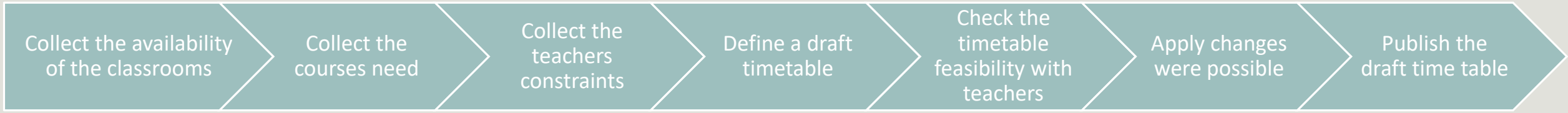
How do you imagine the process for defining the timetable?



…lessons start!

Con questo orario di lezioni, si iniziano le lezioni

How do you imagine the process for defining the timetable?



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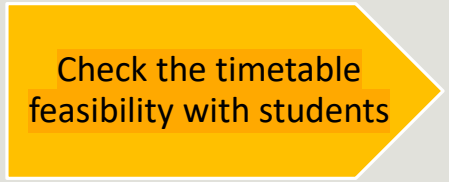

- *Typically overlaps with other courses*

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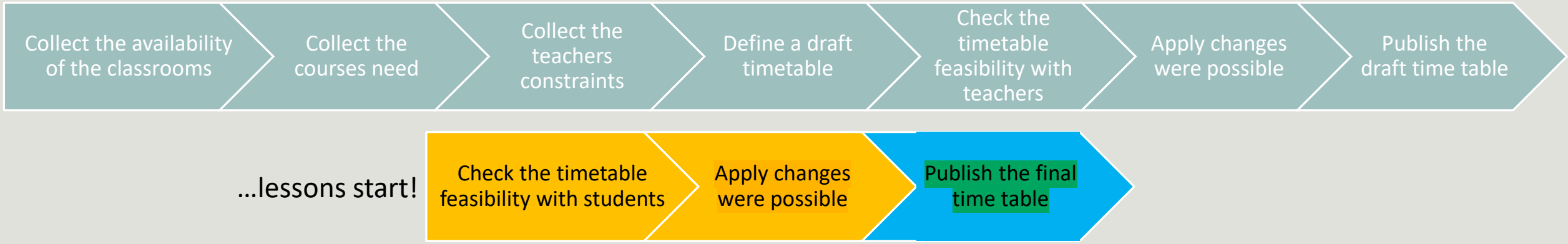

Which agents are involved?

Which agents are involved?

- *The teachers*
- *Teaching commission* Commissione didattica di ogni corso di laurea
- *The Secretary's office* Segreteria didattica
- *The students*

Define the linear responsability chart

Which agents are involved?

- *The teachers*
- *Teaching commission*
- *The Secretary's office*
- *The students*

Flusso di Attività

Orario delle lezioni	Collect the availability of the classrooms	Collect the courses need	Collect the teachers constraints	Define a draft timetable	Check the timetable feasibility with teachers	Apply changes were possible	Publish the draft time table	Check the timetable feasibility with students	Apply changes were possible	Publish the final time table
Teachers										
Teaching Commission										
Secret. office										
Students										

Agenti

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Teachers										
Teaching Commission										
Secret. office	Execute									
Students										

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Segreteria e Docenti lavorano insieme per definire i bisogni di ogni corso
oppure
Parzialmente i Docenti, poi la Segreteria riunisce tutti i bisogni di ogni corso

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Teachers		Participate								
Teaching Commission										
Secret. office	Execute	Execute								
Students										

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Teachers		Participate	Participate	Informed						
Teaching Commission				Approve						
Secret. office	Execute	Execute	Execute	Execute						
Students										

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Students										

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Inizio delle lezioni

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Teachers		Participate	Participate	Informed	Participate	Informed	Informed			
Teaching Commission				Approve		Approve	Informed			
Secret. office	Execute	Execute	Execute	Execute	Execute	Execute	Execute			
Students							Informed			

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Sono i docenti che raccolgono le informazioni riguardanti i vincoli degli studenti (es: sovrapposizione di corsi dove la maggior parte dei studenti partecipa ad entrambi)

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Teachers		Participate	Participate	Informed	Participate	Informed	Informed	Execute		
Teaching Commission				Approve		Approve	Informed			
Secret. office	Execute	Execute	Execute	Execute	Execute	Execute	Execute	Informed		
Students							Informed	Participate		

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Teaching Commission				Approve		Approve	Informed		Approve	
Secret. office	Execute	Execute	Execute	Execute	Execute	Execute	Execute	Informed	Execute	
Students							Informed	Participate	Informed	

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Secret. office	Execute	Execute	Execute	Execute	Execute	Execute	Execute	Informed	Execute	Execute
Students							Informed	Participate	Informed	Informed

Con le prime due domande, ho compreso bene il processo

How can we measure the goodness of the timetable?

In questo esempio, ci focalizziamo sugli indicatori di risultato

Indicatori di obiettivo/risultato: valuta la bontà del risultato
Indicatori Tecnici: valuta la bontà del processo, cioè capire quali fasi hanno funzionato oppure no

Creiamo un piccolo percorso che passa dalla definizione semantica/qualitativa di quali sono i criteri di bontà fino a trasformare questa descrizione in una formula quantificabile e misurabile

Hard constraints must be mandatory satisfied to have a feasible timetable

Come faccio a dire se un orario é buono?

Qualitative goodness criteria are:

- Carico Giornaliero Bilanciato
- Mancanza di Sovrapposizione
- Orario sensato per pranzare
- Per i docenti, soddisfacimento dei Soft constraint

Output del Processo: Orario delle lezioni

How can we measure the goodness of the timetable

Hard constraints must be mandatory satisfied to have a feasible timetable

Criteri Qualitativi di un Buon orario di lezioni

Qualitative goodness criteria are:

- *Maximize the number of satisfied soft constraints*
- *Distribute the daily load for students and teachers*
- *Minimize the number of course overlapping*

sovrapposti

sovrapposizione di due corsi dello stesso corso di laurea e stesso anno

Ora, dobbiamo passare da una descrizione qualitativa ad una descrizione quantitativa

Counting overlapping

A naive counting would sum up the number of hours shared by the courses, but:

- *Several courses run in parallel! Overlaps are the norm!*
- *Not all overlaps have the same severity*

How can we measure overlap severity?

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$$overlap = \frac{2}{\#courses(\#courses-1)} \sum_{i=1}^{\#courses} \sum_{j=i+1}^{\#courses} overlap(i,j)\, weight(i,j)$$

severità overlap

due corsi sono in overlap se sono erogati nello stesso istante

Metto i corsi su una dimensione a confronto con la dimensione del tempo

Abbiamo due matrici:
- Matrice di base
- Matrice dei corsi

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- *overlap(i,j) computes the number of overlapping hours between courses i & j*
- *weight(i,j) returns the severity of the overlapping*

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Sommo tutte le valutazioni incrociate tra i corsi e poi faccio la media

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- *overlap(i,j) computes the number of overlapping hours between courses i & j*
- *weight(i,j) returns the severity of the overlapping*

$$weight(i,j) = \begin{cases} 1 & if\ compulsory(i)\ \wedge compulsory(j) \wedge sameyear(i,j) \\ 0{,}5 & if\ compulsory(i)\ \wedge \neg compulsory(j) \wedge sameyear(i,j) \\ 0 & \neg\ sameyear(i,j) \end{cases}$$

due corsi obbligatori dello stesso anno

due corsi, un obbligatorio con un complementare, dello stesso anno

due corsi non dello stesso anno