Case study – PISA (IT)

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1. Description of Bicycle Share System

Name: CICLOPI (http://www.ciclopi.eu/)

In operation since: May 2013

Operator: Bicincittà from Torino (Italy). There are no subcontractors.

Hardware supplier: Bicincittà (same as operator)

Contract duration: 3 years (started 01-01-2017)

Financing of the contract: The local agency for mobility (Pisamo) collects money from the private parking facilities + pays every year an average of €200.000 per year for the bike sharing system.

2. Operational aspects

Technology: Third generation & RFID(Radio-Frequency Identification)

Registration: Either online, at one of the two sales points or with the smartphone app 'Ciclopi'

Tariffs: When subscribing, the contracting party can chose one of the following kind of subscriptions: annually, weekly or daily:

Subscription	Costs	Extra Rates
Annual	€35 (students: €25)	< 30 minutes: free 30-60 minutes: €0,90 60-90 minutes: €1,50 > 90 minutes: €2,00
Weekly	€10	< 30 minutes: free 30-60 minutes: €0,90 60-90 minutes: €1,50 > 90 minutes: €2,00
Daily	€5	< 30 minutes: free 30-60 minutes: €0,90 60-90 minutes: €1,50 > 90 minutes: €2,00

Operational key figures:

Year	Stations	Bikes	Users	Rentals
2013	14	130	600	90,000
2014	15	140	1000	150,000
2015	18	140	1200	160,000
2016	24	160	1300	160,000

Advanced operation figures:

Year	Registrations	Average rental duration
2013	600	13 minutes
2014	2000	13 minutes
2015	3500	13 minutes
2016	4500	13 minutes

3. City profile

Ing. Giuseppe Forte- Vice Mayor of Mobility: "Pisa has an excellent transport infrastructure, which facilitates air and terrestrial (road/raid) accessibility to the city, an international airport in proximity (less than 5 km from the centre of the city of Pisa), railway links, and a network of motorways, which provide easy access to other major Italian cities.

Pisa can boast the quality of life that is renowned worldwide, which allows companies to attract and retain key skills for business. It possesses an extraordinary historical, cultural, artistic, and architectural urban heritage and a great diversity of landscapes, sea and land, which make it one of the top tourist destinations in Italy and Europe. It benefits from a preserved environment and a high quality of air.

One of the key priorities of Pisa is creating a new protocol on Mobility for 2016 and beyond. For this reason, the city is in collaboration with local institutions, associations and research organizations. The goal is to promote coordinated actions to size the mobility of the future to the needs of the citizens and to encourage the development of alternative transport means to the private car. The Table is chaired by the Municipal Assessor of the Mobility brings together with the City and other local authorities, the CNR, the University of Pisa, the Scuola Normale Superiore, the Scuola Superiore Sant'Anna, the Azienda Ospedaliero Universitaria Pisana, USL, Azienda Regionale per il Diritto allo Studio Universitario, CTT Nord, Camera di Commercio, Ufficio scolastico provinciale, Società della Salute & Pisamo."

4. Marketing & Communication

Key messages: "Pisa cycles Great", "save your time, save your money, ride for your health"

Main target groups: Students (55.000), City Commuters & Tourists.
The Municipality of Pisa has launched a public survey about people needs on urban mobility. The campaign -realized by Pisamo and the National Research Centre of Pisa- has been successful,

(with the participation of over 6220 citizens), and it has been focused on people needs for a better development of an efficient and sustainable urban mobility. The analysis of the collecting data will allow to decide the further strategies for the city.

Pictures, video links and graphs: www.ciclopi.eu ,
https://www.youtube.com/watch?v=EQpXr64X3AE

1.
Let us
look around

Pisa has a central position within the Mediterranean, which over time has made it a centre of exchange and communication with the Mediterranean and the ports of Europe.

PISA		TUSCANY	
• Population	89.991	3.692.828	
• Population density	466 inhabitants/km²	161 inhabitants/km²	
• Surface	185.2 km²	22.987.04 km²	
• Population residing within the metropolitan area (2014)	110.000		
• Companies present	37.372	357.362	

October 2014 vital statistics from Pisa Municipality *2014 data from Pisa's COAA (Chamber of Commerce, Industry, Crafts and Agriculture)*

A Quantitative Approach to the Design and Analysis of Collective Adaptive Systems for Smart Cities

by Maurice ter Beek, Luca Bortolussi, Vincenzo Ciancia, Stefania Gnesi, Jane Hillston, Diego Latella and Mieke Massink

It's smart to be fair. Researchers from the Formal Methods and Tools group of ISTI-CNR are working on scalable analysis techniques to support smart applications for the efficient and equitable sharing of resources in the cities of our future. The research is being carried out under the European FET-Proactive project, QUANTICOL.

Figure 1: public bike-sharing system (CicloPi) in Pisa

The Smart City concept is on the research agenda of many European Union (EU) and other international institutions and think-tanks. As urban populations grow, innovative information and communication technology (ICT) initiatives are seen by many as one of the key factors that will allow modern cities to reach or maintain a good and sustainable quality of life for their inhabitants, allowing for the timely and equitable distribution of resources.

These ICT-based systems are based on decentralised and distributed designs, comprised of many autonomous and interacting entities, known as collective adaptive systems (CAS). CAS are required to adapt their services seamlessly to the changing needs of their users, who also form an integral part of the system. They typically consist of a large number of spatially distributed, heterogeneous entities with decentralised control and varying degrees of complex autonomous behaviour. This requires the development of novel scalable analysis techniques to investigate their dynamic behaviour and support the design and operational management of a wide range of such systems. In the QUANTICOL project [1], three principal case studies drive the development of a design and analysis framework for CAS: two smart urban transportation systems (smart bus systems and bike-sharing schemes) and smart grid applications. We present some of the QUANTICOL research performed at ISTI-CNR.

In the first year of the project, we developed several scalable analysis techniques that exploit mean field and fluid flow techniques, in combination with logic-based model-checking, to support the investigation and prediction of dynamic resource usage. Mean field techniques were originally developed in the field of statistical physics to cope with the analysis of very large scale systems composed of inter-

acting objects such as molecules in a gas. The possibly non-linear behaviour of such systems is conveniently modelled by a deterministic approximation, i.e., the limit for an infinite number of agents, given as the solution of a set of differential equations (in the continuous case) or difference equations (in the discrete case). Their combined application with model-checking techniques provides a way to verify properties of individual entities in the context of a large system on which they depend, but also properties of the global system or combined local and global properties. An example is the study of the potential effects of user-incentives on maintaining a satisfactory distribution of bikes and empty parking slots over time. The extension of these techniques to address spatial aspects, including spatial model-checking, is a major objective of the project [2].

A further objective of QUANTICOL is to study the relationships between (representations of) small populations and a compact (family) representation of a large population 'built' from these smaller populations, by indicating the commonalities and variabilities of single entities in their overall environment. As an initial step in this direction, we performed variability analyses on a bike-sharing product line, considering its behaviour to exhibit variability, not only in the kind of features involved but also in the timing and probability characteristics of these features.

In this context, ISTI-CNR initiated a collaboration with "PisaMo S.p.A. azienda per la mobilità pisana", an in-house public mobility company in the Municipality of Pisa, that had recently introduced a public bike-sharing system (CicloPi) in Pisa. This led to an initial feature model of a family of bike-sharing systems, annotated with attributes and global quantitative constraints aiming to

minimize the total cost of a chosen configuration while simultaneously aiming to maximize customer satisfaction and capacity (of docking stations).

We have studied the specification and analysis of the possible behaviour of a family of bike-sharing systems in terms of the capacity of their docking stations in a value-passing modal process algebra, considering a dynamic redistribution scheme as an optional feature. Future work includes studying a further parametric extension of the value-passing modelling and verification environment as well as the addition of a quantitative dimension to the behavioural model.

QUANTICOL will run until March 2017 and is coordinated by Jane Hillston from the University of Edinburgh (UK). Other partners are EPFL (Switzerland), IMT Lucca (Italy), University of Southampton (UK), LMU (Germany), INRIA (France) and ISTI-CNR (Italy). We thank Marco Bertini from PisaMo S.p.A. for generously sharing his knowledge on bike-sharing systems with us.

Links:
QUANTICOL: http://www.quanticol.eu/
PisaMo: http://www.pisamo.it

References:
[1] L. Bortolussi et al.: "A Quantitative Approach to the Design and Analysis of Collective Adaptive Systems, FoCAS '13, Taormina, Sicily, Italy, 2013.
[2] J. Hillston: "Challenges for Quantitative Analysis of Collective Adaptive Systems", TGC 2013, Buenos Aires, 2013, Springer LNCS, Vol. 8358, pp.14-21, 2014, DOI: 10.1007/978-3-319-05119-2_1.

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About VeloCittà:

The European VeloCittà project brought together five cities that seek to improve their existing bike sharing schemes. In London (UK), Krakow (PL), Burgos (SP), Padua (IT) and Szeged (HU) the performance of the bike sharing system was enhanced through two complementary approaches. On the one hand marketing campaigns tailored to certain target groups, like students or commuters. And on the other hand adoption of most effective available operational solutions with regard to organisational and financial aspects as well as political involvement. The ultimate benefit of VeloCittà is that it provides inspiration and builds capacity and knowledge in local authorities and bike sharing stakeholders to boost the uptake of bike sharing.

VeloCittà is a demonstration project funded by the Intelligent Energy Europe Programme of the European Commission. It had 11 project partners and ran from March 2014 - February 2017.

For more information, questions, project outputs and reports, please visit www.velocitta.eu or send an email to info@dtvconsultants.nl

Partners: