



Interaction Flow Modeling Language

Internet of Things and Internet of People: The Role of User Interaction in the IIoT vision

Marco Brambilla

 marco.brambilla@polimi.it

 @marcobrambi





Context and need

Specification of IoT and IIoT so far focused mainly on machine-to-machine interactions

- Things talking to things

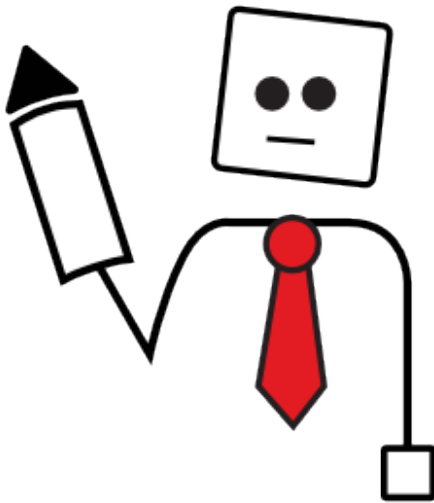
But ultimately human contribution must be in the loop!

- Reporting
- Data visualization
- Data analysis
- Data exploration
- Decision making
- Storytelling



The UI Design Problem – UIs for IIoT

The last mile to the user: Costly and inefficient process



Complexity of user interfaces (UIs)



Ineffective design tools



Manual specification of data and visualization



No support for human interpretation of data



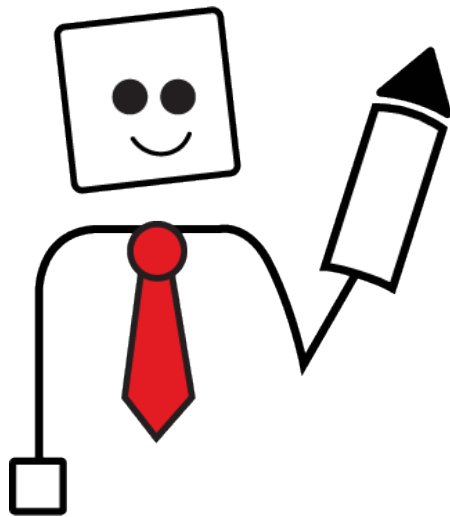
Standardization gap

- Hence **the Interaction Flow Modeling Language (IFML)**





The UI Design solution: IFML



Platform independent
description of UIs



Focused on user
interactions



No definition of
graphics and styles



Reference to
external models



IFML Objectives



Content
of the UI

Interaction
Options and
Navigation Paths

User and
System Events

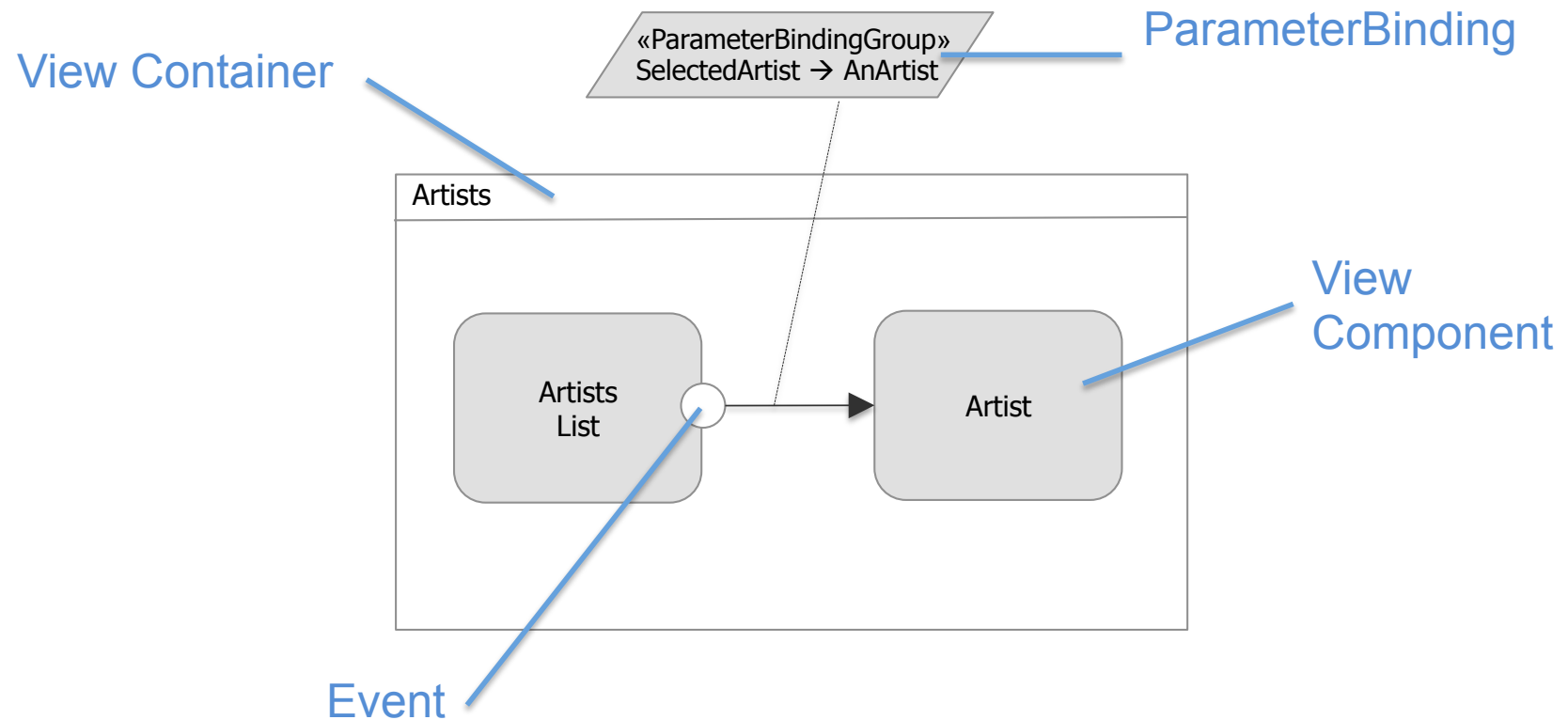
Binding to
Business Logic

Binding to
Persistence Layer
(data storage)



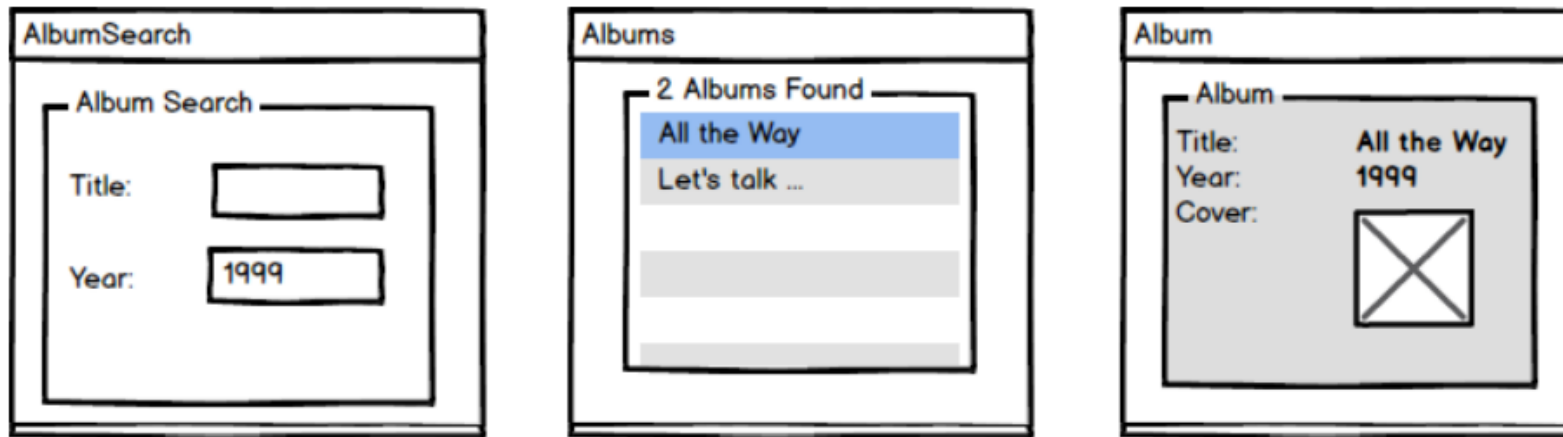
IFML by example

Artists	
Artist Index Andrea Bocelli Celine Dion Frank Sinatra The Beatles	Artist First Name: Celine Last Name: Dion Photo: 



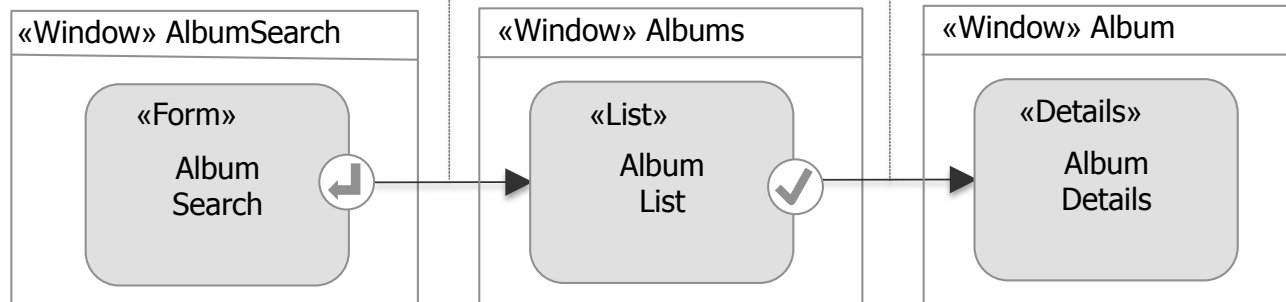


IFML by example



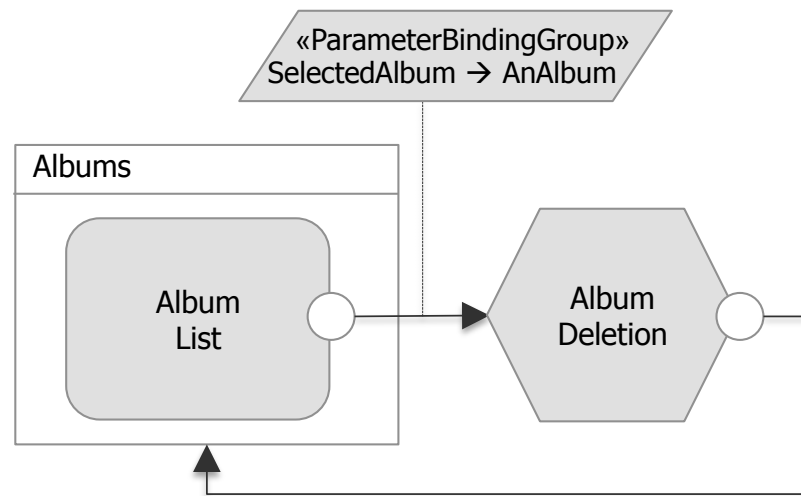
«ParameterBindingGroup»
Title → AlbumTitle
Year → AlbumYear

«ParameterBindingGroup»
SelectedAlbum → AnAlbum





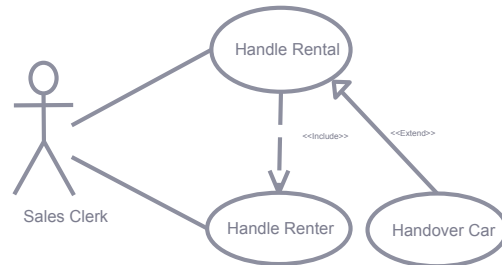
IFML by example



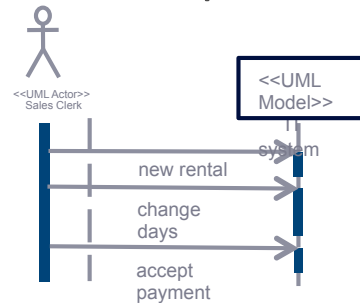


Multiple aspects modeling

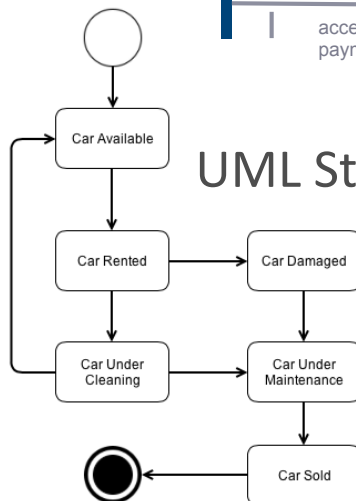
UML Use Case



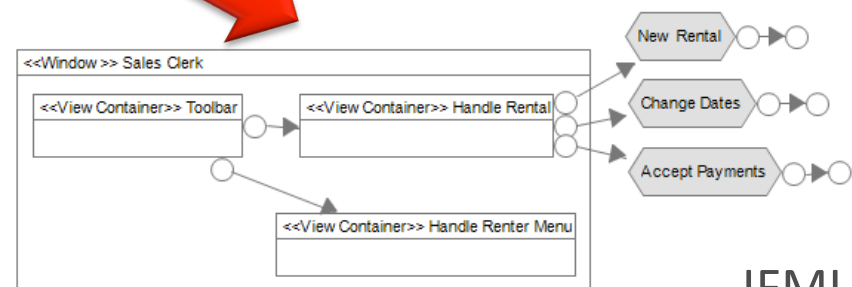
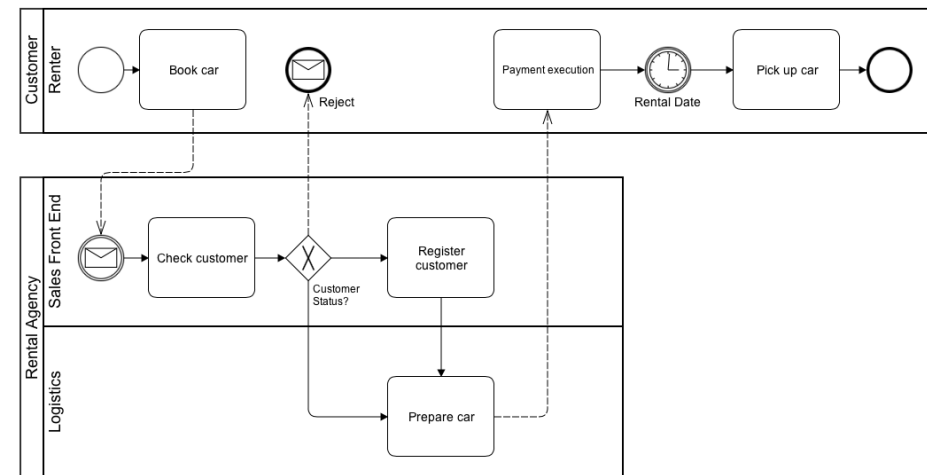
UML Sequence



UML Statechart



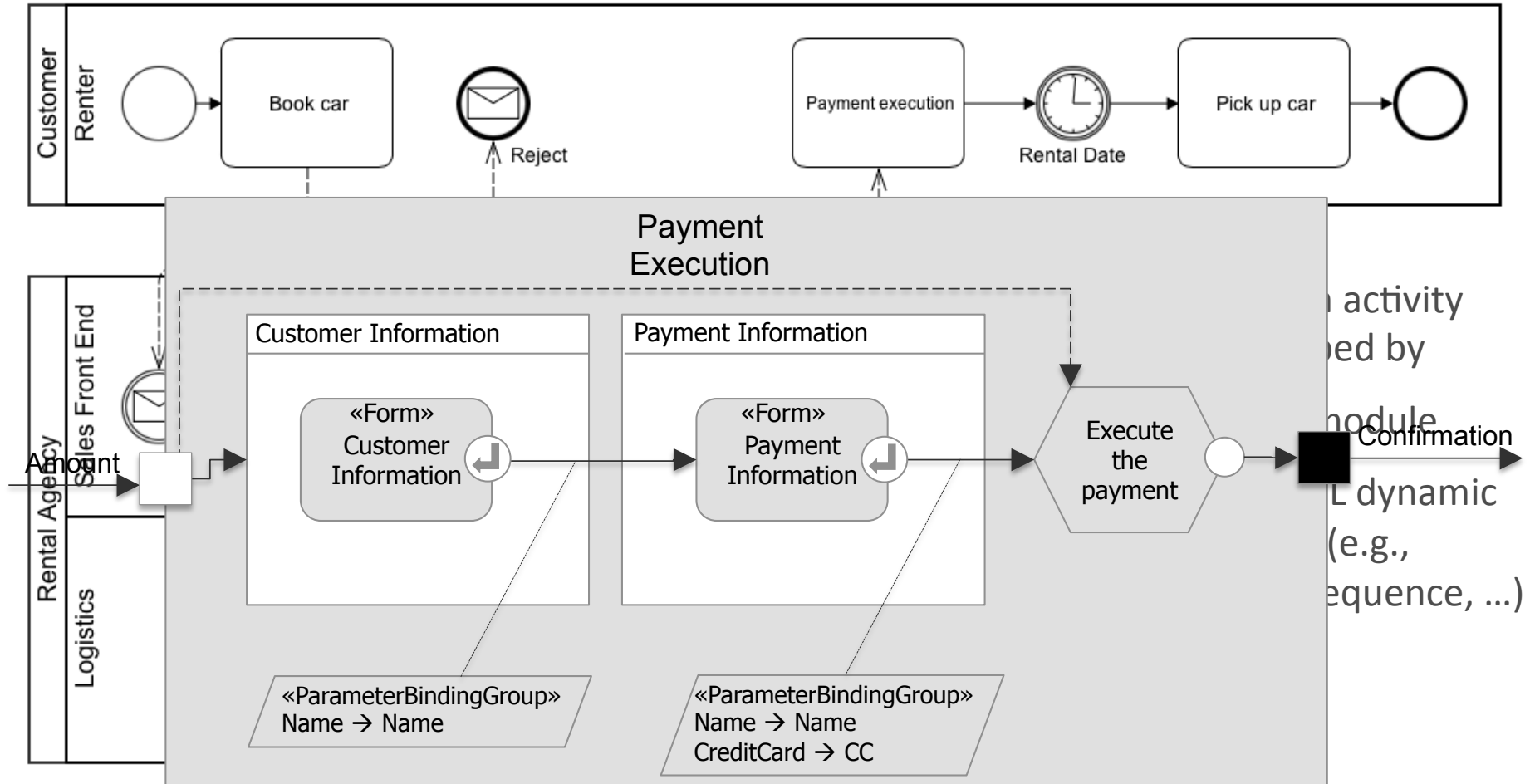
BPMN process



IFML



Integration with BPMN



activity
ed by
module
Confirmation
dynamic
(e.g.,
sequence, ...)



Executability

Given that IFML is an EXECUTABLE model...

- Possibility of complete code generation of the Uis
- Extremely quick time-to-market
- Reliable and bug-free code
- Repeatable, reusable, and coherent resulting UI



Successful IFML projects in industry





Success Stories of IFML and WebRatio



GE Capital Fleet Services

Fleet Management System
integrated with legacy systems and
high standard security

1 million lines of code
500 user interaction flows
Used in 3 countries
By 150K-200K users



UniCredit Leasing

Online leasing quotations
Creditworthiness evaluation
system
Building construction check-up
system

More than 11 million lines of code
220 roles
4,680 user interaction flows



Worldwide public portal
www.acer.com

Workflow system for managing
content production, approval and
visualization

60 Countries
22 Languages
more than 1 million visits per day



Q&A and internal trouble ticket
system
System for organizing cash register
intake at the end of the day

Euro 29.2 billion "Cash Mgmt
System" Powered by WebRatio
Used in 42 Countries by 1,620
employees



General Electrics – Fleet Services

A Web Intranet managing all the information about the core objects of the Fleet Services business: drivers and vehicles.

A set of dashboards, to allow fleet managers to monitor the costs and performance trends of their fleets.





Developed Applications: Program and Materials

001454 GE Unit #: 0000001

Data as of : Thu May 29 2014 6:30:04 PM CDT ?

Edit Vehicle



Vehicle

Edit +



ON ROAD

Since 03/14/2012

Sticker

2012 FORDX ESCAPE 4X4 S

Assigned Person

Change +



AARON PARR

EMPLOYEE ID

E1184785

Message

Additional Detail

+

Details

Activity

Billing

Program Materials

Remarketing

Auto Maintenance Mgmt.

INSTRUMENT NO XXXXXXXXXXXX8508

INSTRUMENT STATUS Active

LAST ISSUED 11/11/2013

EXPIRATION 02/28/2017

? **DRIVER AUTHORIZED** 75

LIMIT

PIN 0713

[Instrument History](#)

[Mailing History](#)

**ACTION -
REASON**

No Action

Accident Services

INSTRUMENT NO A135320871

INSTRUMENT STATUS Active

LAST ISSUED 02/14/2012

EXPIRATION 02/28/2015

[Instrument History](#)

[Mailing History](#)

**ACTION -
REASON**

No Action

Submit

Reset



Vehicle - Billing

001454 GE Unit #: 0000001

Data as of : Thu May 29 2014 6:30:04 PM CDT ?

Edit Vehicle



Vehicle

Edit



ON ROAD

Since 03/14/2012

Sticker

2012 FORDX ESCAPE 4X4 S

Assigned Person

Change



AARON PARR

EMPLOYEE ID
E1184785

Message

Additional Detail



Details

Activity

Billing

Program Materials

Remarketing

Vehicle Billing Structure

Event Dates

Vehicle Expense Overview

Sales Adjustments

Vehicle Billing Structure

Edit

Structure Details

LEVEL 2 612102

LEVEL 3 006450

LEVEL 4 006430

LEVEL 5 000000

LEVEL 6

Contract Details

SUB CONTRACT SW13

CONTRACT TYPE OPERATING LEASE (L2)

FINANCE TYPE FIXED

Life Cycle Details

CLIENT PO NUMBER ?

CAPITALIZED COST \$23,338.00

BOOK VALUE \$13,278.52

AMORT TERM 60

Service Programs

ACCIDENT SERVICES

AUTO MAINTENANCE
MGMT.

DRIVER CARE

DRIVER HISTORY REVIEW



Vehicle – Expense Overview

001454 GE Unit #: 0000001

Data as of : Thu May 29 2014 6:30:04 PM CDT ?

Edit Vehicle



Vehicle

Edit



ON ROAD

Since 03/14/2012

Sticker

2012 FORDX ESCAPE 4X4 S

Assigned Person

Change



AARON PARR
EMPLOYEE ID
E1184785

Message

Additional Detail



Details

Activity

Billing

Program Materials

Remarketing

Vehicle Billing Structure

Event Dates

Vehicle Expense Overview

Sales Adjustments

Vehicle Expense Overview

June 2014

Export

Overview

	Rental	Maintenance	Fuel	Accident	Support	Total
Current Invoice Cost	\$478.73	\$0.00	\$348.52	\$0.00	\$60.63	\$887.88
Life Of Unit Invoice Cost	\$13,207.81	\$264.39	\$15,356.44	\$0.00	\$2,655.33	\$31,483.97
Average Monthly Invoice Cost	\$489.18	\$9.79	\$568.76	\$0.00	\$98.35	\$1,166.08

Fuel Overview

Current Invoice Cost per Gallon/Liter	\$1.18
Current Invoice Quantity	295

Estimated Mileage Overview

Last Odometer Reading	96752.00
Odometer Date	02/26/2014



Developed Applications: Performance dashboard

Good Morning

Feedback | Profile | Help | Resources | Sign Out

Corp: All | Fleet

Search for vehicle

Search

Advanced Search: All

Manage | Analyze

Analyze Performance



Saved Views

* fuel and maint

Billing Period

Fleet

Date Selection

* Calendar Type

Billing Period

* Period Type

Month

* Periods

3 Selected

Levels Selector

* Country



* Fleet

1 Selected

Level 2

Select options

Level 3

Select options

Level 4

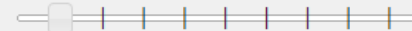
Select options

Show Data By (Series)

Body Type

BENCHMARK ?

90% sales



10% service

Apply

Show Benchmark



Fuel

Fuel Cost Per Mile(km)

Stacked Bar (Vertical)

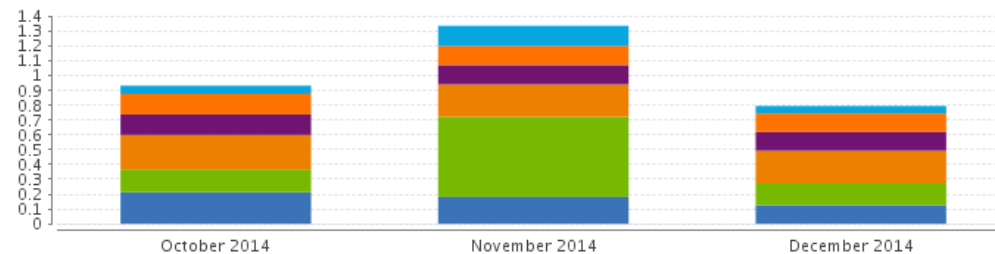
\$0.1358

Trend (Oct14' / Dec14')

8.25 % -\$0.0117

Variance (Nov14' / Dec14')

2.33 % -\$0.0031



+ Add Fuel Performance Indicator



**Developed with
85% time reduction**



SmarterWater: online portal



Front-end

Web portal
and mobile
app for
customers

Admin
Dashboard
for the water
supplier

Back-end

Cloud + Big Data
infrastructure

Smart meters and
other home sensors





SmarterWater: online portal



Online billing and payment



Dashboard for consumption control



Real-time data from smart meters at home



Comparison with optimal consumption



Teaching and resources on water



Gamification



Leaderboard, objectives and badges, points





SmarterWater: Admin Dashboard

- Performance of the program
- Customer segmentation
- Geospatial analytics
- Alarms for spills and exceptional consumption
- Management of materials and training
- CRM





Management of breakdowns on country-wise electrical network

A web system for electrical supply network supporting

- Monitoring of the network
- Request, planning, and execution of maintenance
- Reporting and analytics

For ordinary maintenance, malfunctionings, accidents of 130,000 network nodes and 33,000 production units



Management of breakdowns on country-wise electrical network



B

Accettazione Programmazione Delibere Scadenario Stato Operativo Gestione Vincoli Inserimento Storico Report Amministrazione

Indisponibilità da Programmare

Tipo di Piano

Codice

Tipo

Data Da

☒ Tutti ☐ Rete ☐ UP

Elemento

Tipo Elem.

Unità T.

Stato

Cluster

Tensione

☒ Proprie ☐ Tutte

primoprecedente1 a 50 di 1013successivoultimo

vai a 1 2 3 4 5

☒	Stato	MOD	Del.	Tipo	Tensione	Tipo	Elemento	Inizio Progr.	Fine Progr.	Inizio FLEX	Fine FLEX	Rientro	RSE	TRB	TRL	N° Vinc	AEP		
☐	ESE		D	IOC	220 kV	UPI	UP_CARDANO_1 - CARDANO - UP_CARDANO_1	25/08/14 7.59	30/04/15 16.59	25/08/14	30/04/15	no	no	0	0	0	VE		
☐	ESE		D	IAN	220 kV	UPI	UP_SOVERZENE_1 - SOVERZENE - UP_SOVERZENE_1	01/09/14 7.59	28/06/15 16.59	01/09/14	28/06/15	no	no	0	0	0	VE		
☐	ESE		D	IOC	132 kV	UPI	UP_PONTE_GAR_1 - PONTE GARDENA - UP_PONTE_GAR_1	15/09/14 7.59	30/04/15 16.59	15/09/14	30/04/15	no	no	0	0	0	VE		
☐	ESE		D	IOC	132 kV	UPI	UP_PONTE_GAR_1 - PONTE GARDENA - UP_PONTE_GAR_1	15/09/14 7.59	30/04/15 16.59	15/09/14	30/04/15	no	no	0	0	0	VE		
☐	ESE		D	IAN	132 kV	UPI	UP_CASTELLET_1 - CASTELLETO - UP_CASTELLET_1	24/11/14 0.00	17/04/15 0.00	24/11/14	17/04/15	no	no	0	0	0	VE		



IFML use for electric network case

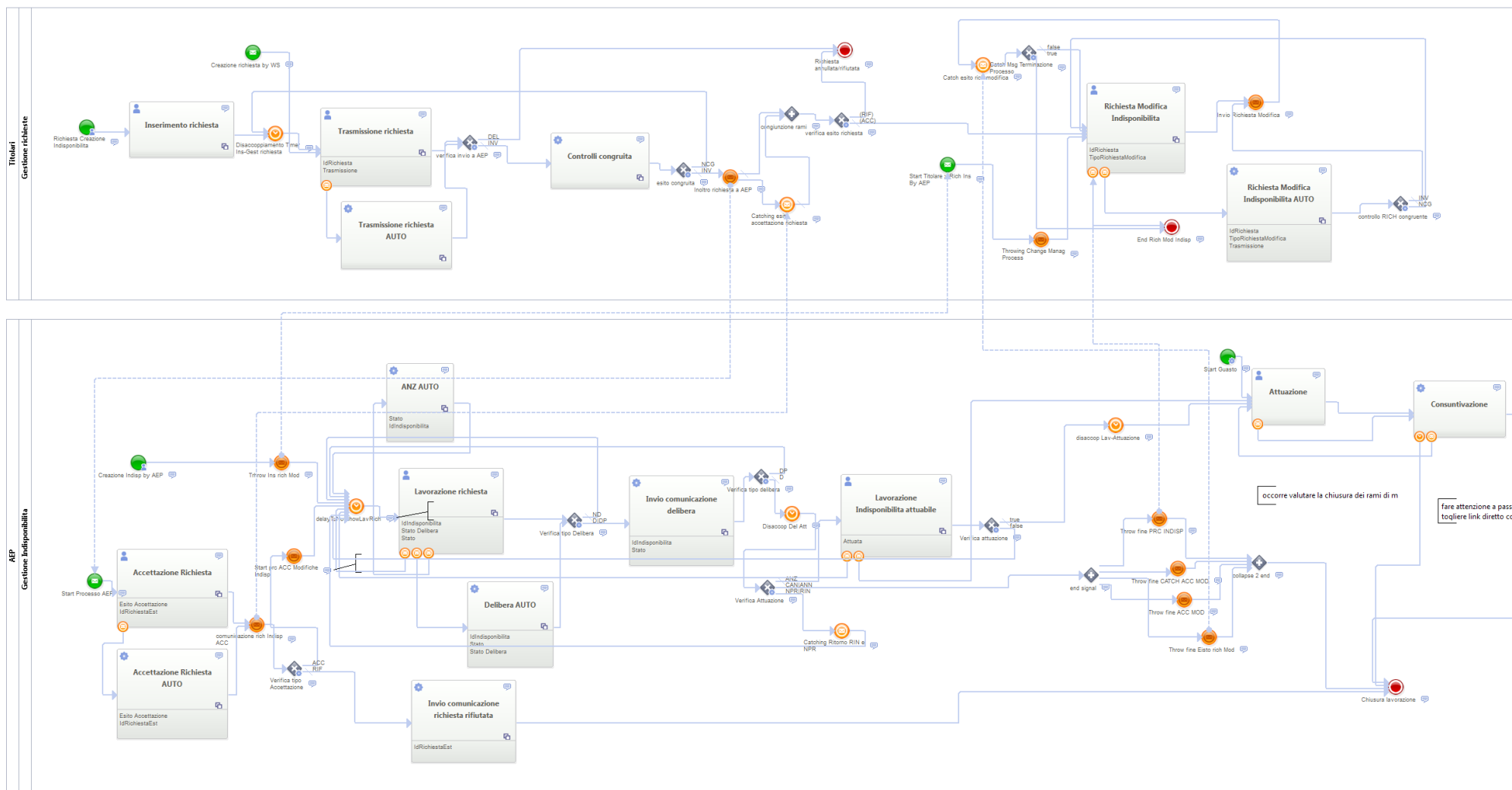
UI specification with IFML

Integration with BPMN business process specification

Monitoring of IIoT devices on the network nodes

Scheduling, web service interactions

Analytics and visualization: Gantt, Timeline, Excel, PDF





Titolare	E.ON ENERGY TRADING		
Unità Titolare	E.ON - RETE		
Tipo	IAN	Codice	TERNA-2015-0000233
Stato	ACC	Modifica	Delibera ND

Elemento	04OSCM11_NE_945 - OSTIGLIA Stl OSTIGLIA ST 400 kV		
Tipo	STL	Tensione	400 kV
Int. Naz.	si	RTN	si

Data Inizio	25/03/15 10.17	Data Fine	31/03/15 10.17
Inizio FLEX	01/01/15	Fine FLEX	31/12/15

Titolare Interferente	ACEA ENERGIA HOLDING
Unità emittente PDL	
Centro di Lavoro Resp.	

Classe Lavori	SVI	Classe lavori AEEG	SVI
Tipologia Lavori	LCON002 - Verifica Impianto di Terra Sostegni - Controlli URSC-REM		
Anticipo Delibera	no		
Cod. Cluster			

Tempo Rientro Breve	30	Terre in linea	no
Tempo Rientro Lungo	60	Risorse esterne	no
Rientro	☐ si ☒ no	Lavoro in ombra	no
Rientro Sabato	☐ si ☒ no	Rientro Festivi	☐ si ☒ no
Regime Speciale	no		

Note Titolare	
Note Gestore	
Promemoria	

Disalimentazione	☐ si ☒ no
Impianto in Antenna	☒ si ☐ no
MW in antenna	190
MW controalimentati	100
Tipo controalimentazione	Totalmente Controalimentabile
MW indisponibili	90
Salva	

Conseguenze	
Primaria	CTE
Secondarie	
CTE	
Volume energia	100
Configura	

Visibilità

Visibilità da sistema	AEP Configurate
MI	Lista vuota
Configura	

Vincoli

Titolo	Codice	Delibera	Stato	Tipologia
Prova_vincolo	CC-201500001	ND	NAT	Produzione Limitata
Crea	Associa			

Allegati

Tipologia Documento	Data	Nota Allegato	Nome Allegato
Proca caricamewnto file	25/03/15 10.18	nota nota	Brezzi_intervento_Napoli_Babel.pdf
Allega			



Giorno corrente: 03/03/15 Proroghe: 0 Logout Benvenuto User Demo CR ROMA (C

Eventi Indisponibilità Fatti rilevanti Notiziario Reporting Anagrafica Amministrazione

» Eventi » Lista Eventi

No Assetti ☒ No Indisp ☒ Genera Report PDF

Lista Eventi

Data I.	Data F.	Tipo	Denominazione	Cod. Eve.	Sottotipo	FR	Nota evento	
20/01/15 12.00		LIN	LINEA 508 SEZZE FS - CISTERZI	PT-SC	Intervento prot. CAP		scatto	   
11/01/15 15.00		TRC	FORLI' FANO E.T. (350)	VL	Tensione/Corrente		max I	   
11/01/15 15.00		TRC	FORLI' FANO E.T. (350)	VL	Tensione/Corrente		max I dupli	   
11/01/15 13.00		LIN	LINEA 578 COTILIA - ROCCA SIN	VL	Tensione/Corrente		superato V	   
11/01/15 12.00		STL	MONTALTO - SUVERETO 1400 kV (823)	VL	Mediana		max mediana aaa...	   
02/01/15 12.22		STL	ANAGNI ZI AL - VALMONTONE 150 kV (1231)	PT-SC	Intervento prot. CAP		IoremPusumLoremPusumLoremPusumIoremPusumLoremPusumLoremPusumIoremPusumLoremPusumLo...	   
31/12/14 16.30		TRC	ABELSITO A.TOR DI QUINTO (402)	DI	Disalimentazione sito		test dettaglio disalimentazione	   
29/12/14 09.20		STL	VILLAVALLE - SNIA-RIETI 150 kV (5601)	PT-SC	Intervento prot. CAP	di	SCATTA cap1 a VLV	
27/12/14 19.28		STL	COLONNETTA - VACONE 150 kV (867)	AR-MA	Emergenza		Apertura per urgente ripristino SF6 (vedi mail)	   
26/12/14 10.38		LPT	TORREVALNORD - UP_TORREVALN_3	GR	Blocco/Scatto Gruppo		AVARIA GRUPPO3.	   
24/12/14 19.00		LPT	NERA MONTORO - UP_NERA_MONT_1	GR	Blocco/Scatto Gruppo		aaaaaaaaaaaaaaaaaaaaaaaaaaaaa	   
24/12/14 13.40		STT	FANO E.T. - ATR2 380/132 132 kV	AR-MA	Tensioni		Aperto secondario.	   
24/12/14 13.40		STK	FANO E.T. - PARALLELO K 132 kV	AR-MA	Tensioni			   
23/12/14 00.07		LIN	LINEA 333 VILLANOVA - VILLAVALLE	AR-MA	Tensioni			   

Data inizio  Ora inizio Data fine  Ora fine

Nota evento



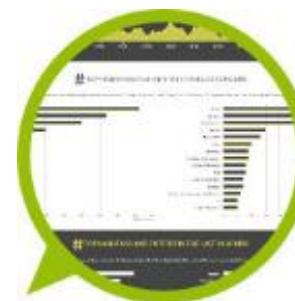
A real case: **eventometers**

event analytics & engagement

MEASURE AND IMPROVE THE INTERACTION AT YOUR EVENTS

Social Network Analytics

Mobile App



IoT Data



Attendance
profiling



People
Counting



Internet of Things and Sensors



Sensors to measure
(visitors flow and attendance
environmental data as
temperature, pressure and
humidity)



Sensors to interact
(proximity to points of
interest, users profiling
age, ethnicity, gender)

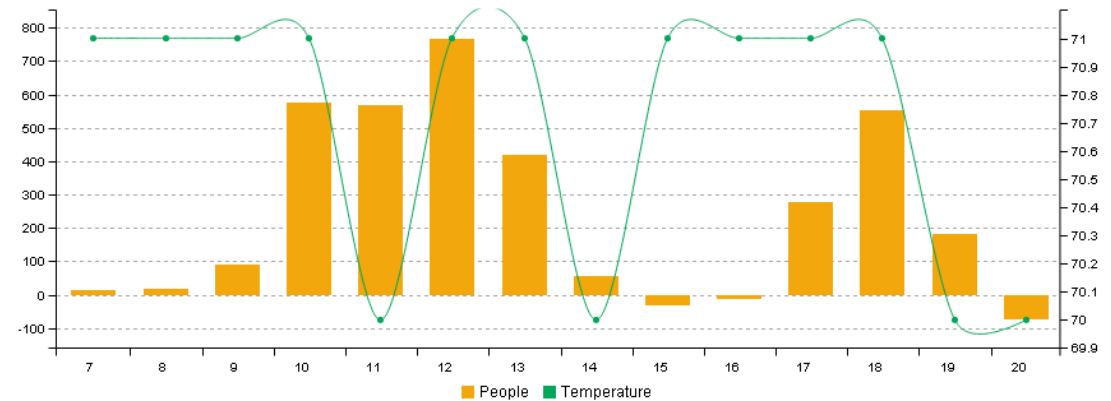


Live event monitoring

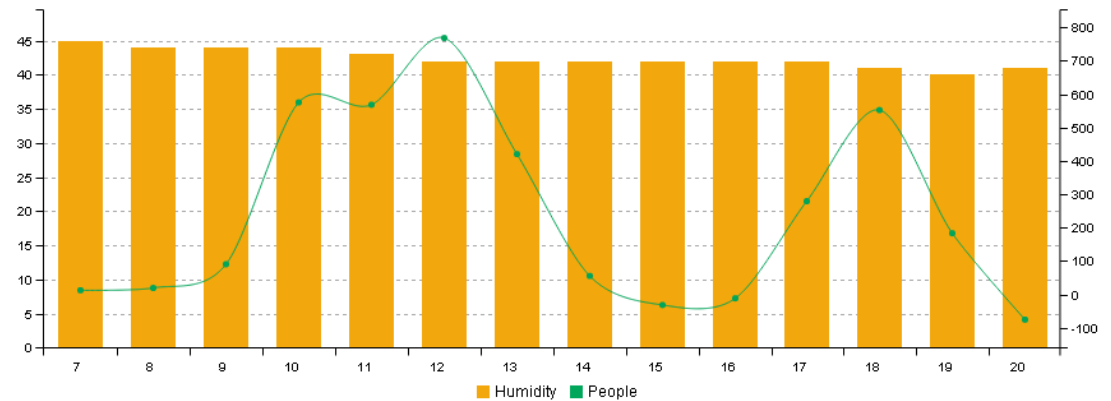
Enable data sharing
and decision
making

Exhibit Hall

People In/Out and temperature correlation per hour



People In/Out and humidity correlation per hour



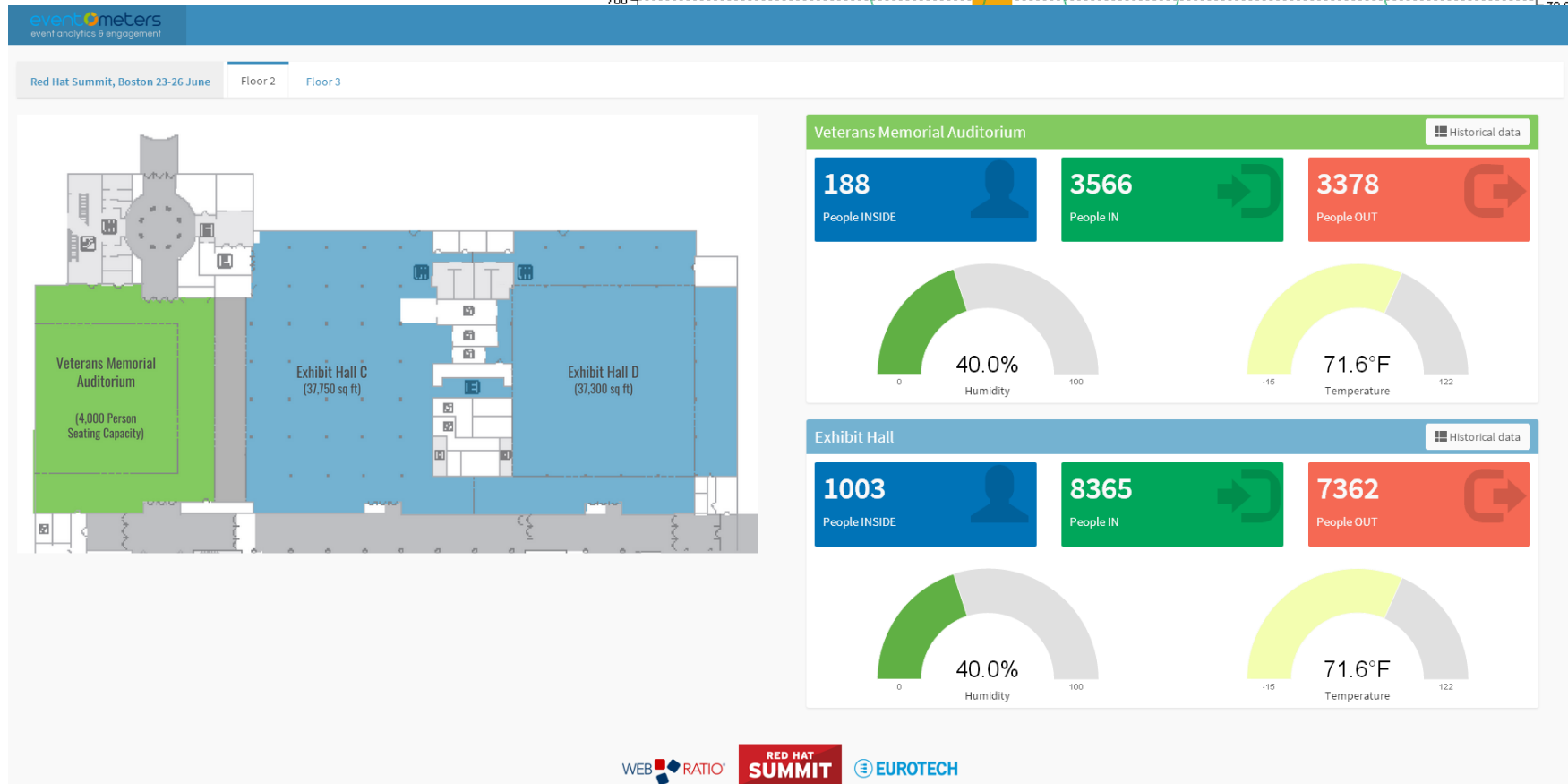


Live event monitoring

Enable data sharing
and decision
making

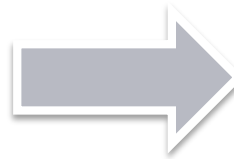
Exhibit Hall

People In/Out and temperature correlation per hour

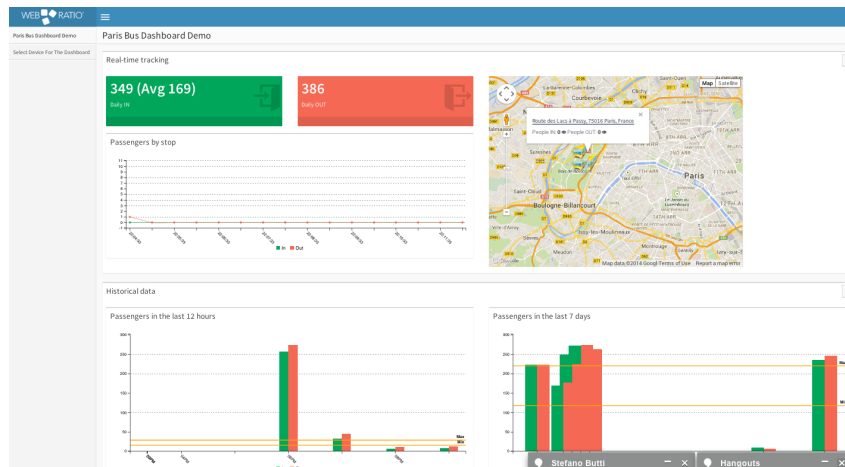




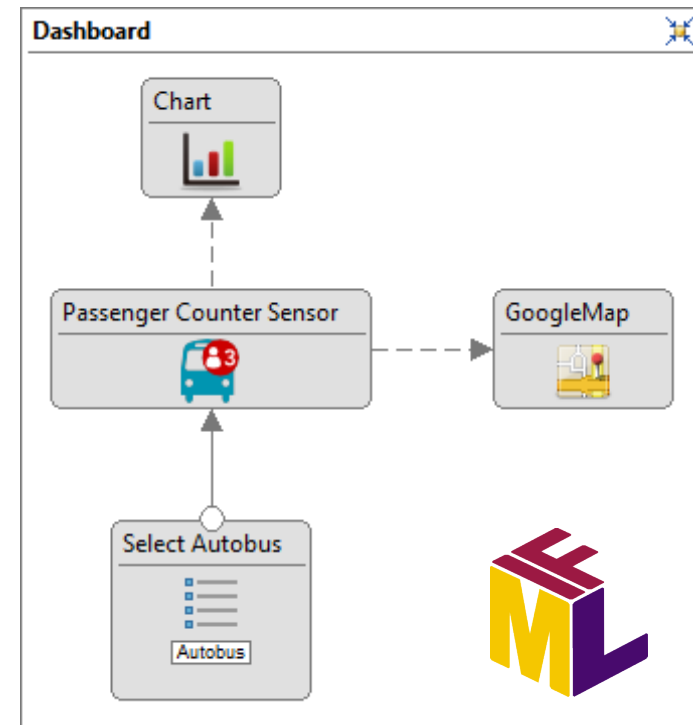
People Counting



Real time data from sensors
People counters + Cloud data storage



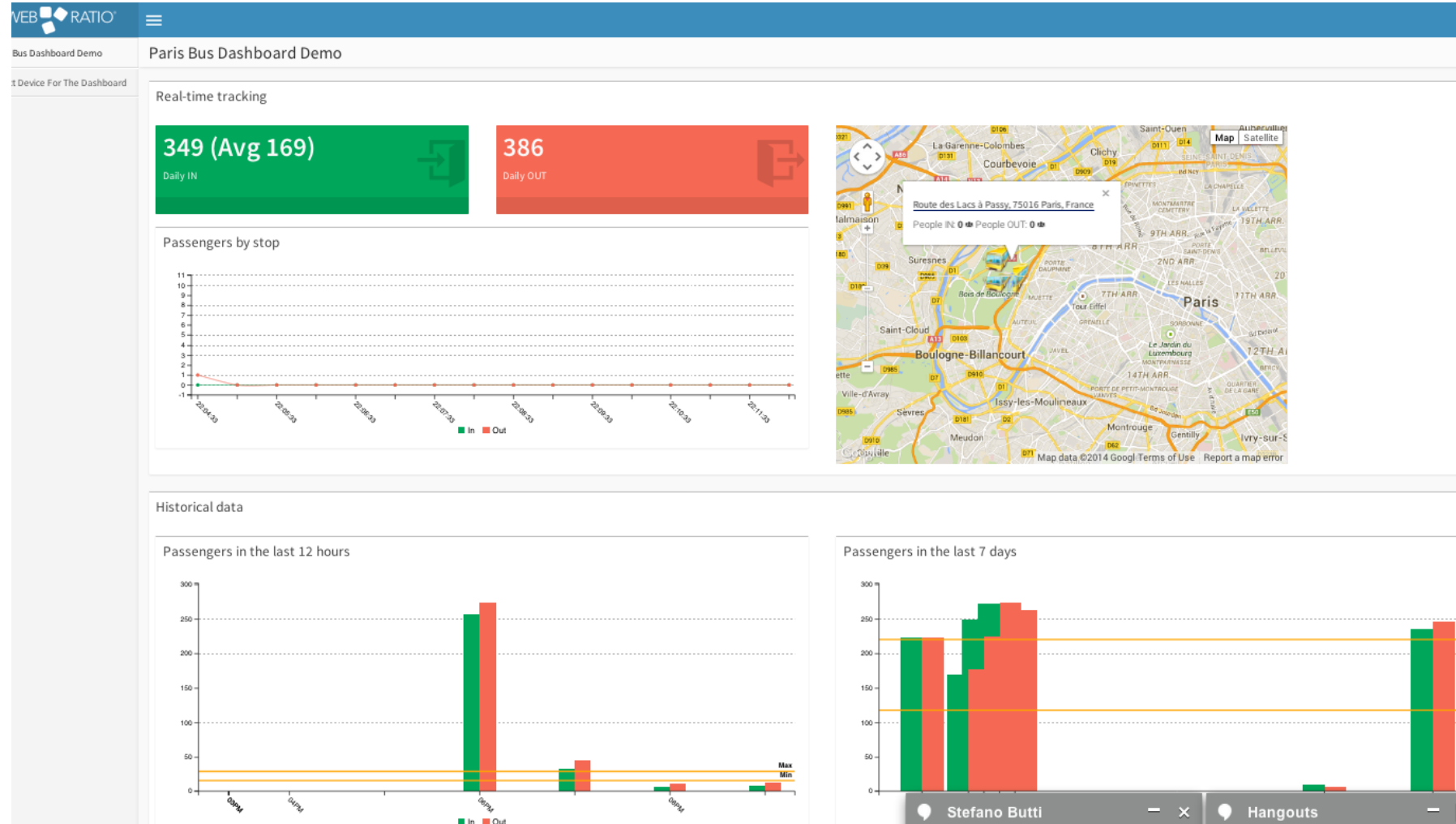
Mobile and Web App
Front-end + Back-end



Models in IFML



Passenger counter on buses





Internet of (Green) Things

IIoT in agriculture needs user monitoring and interaction too

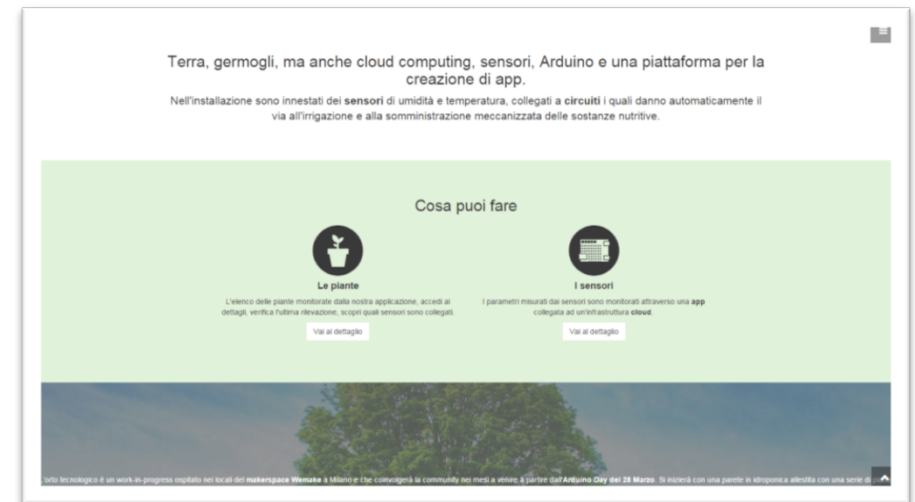
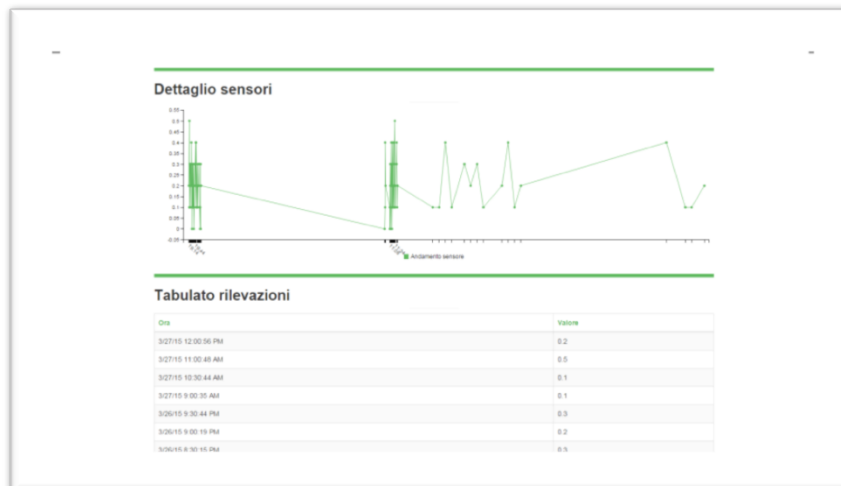
www.internetofgreens.com





Ilo(green)T

A **Web app modeled with IFML** is connected to cloud, **showing real-time parameters of sensors** implanted in the fields and pots that detect the garden's humidity, temperature, conductivity and pH.

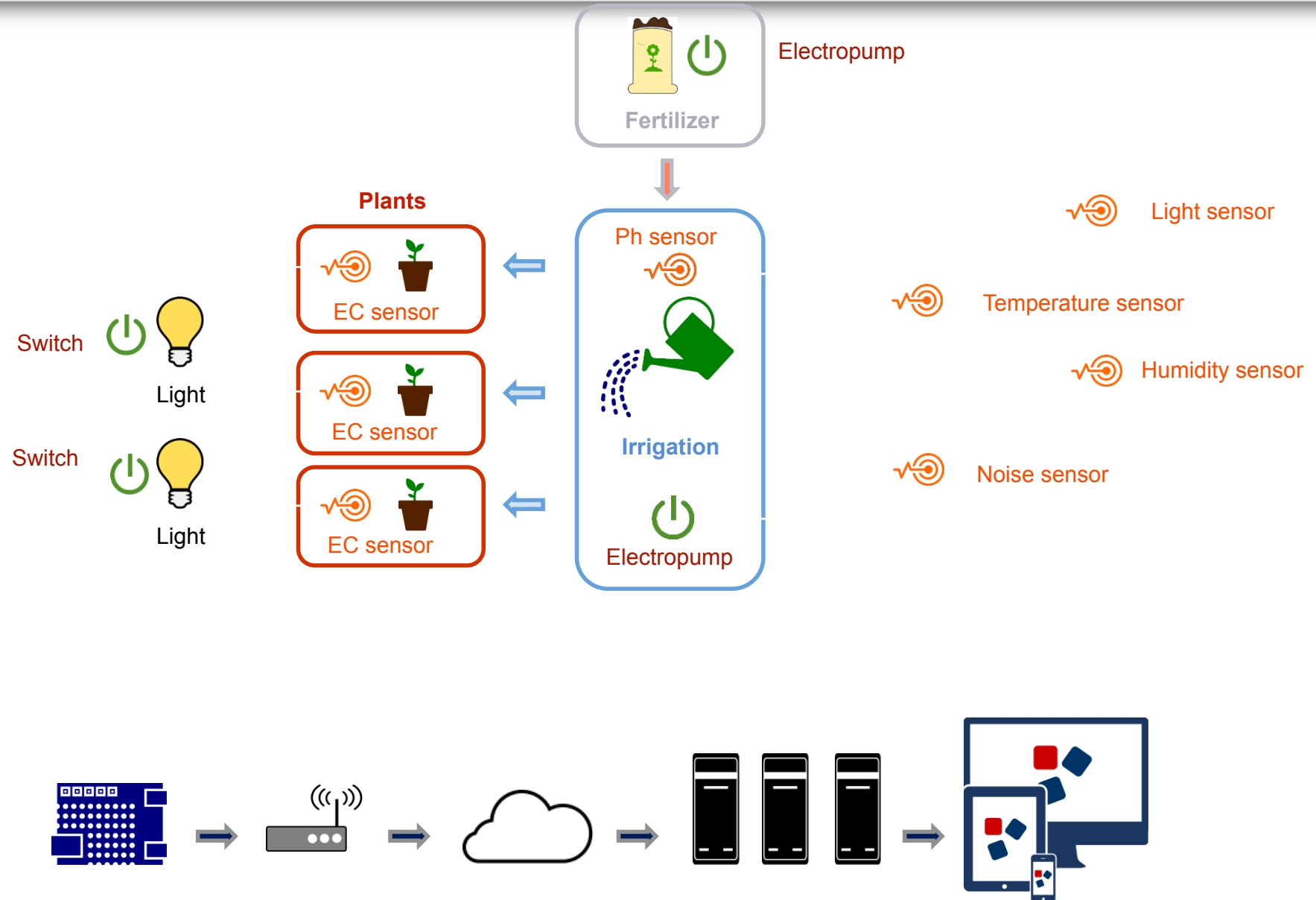


These sensors are connected to circuits that automatically irrigate and provide the garden with nutrients when necessary. Special grow lamps as well as natural lighting illuminate everything.

Users can take decisions on how to act.



How it works





Take home message

IoT is not just about “T”s!

- People matter and need to be in the loop

You need coherent and consistent methods for covering design of things and people perspectives

IFML can be the tool for this

For more info, look up

www.ifml.org

Thanks!



Marco Brambilla

 marcobrambi

marco.brambilla@polimi.it



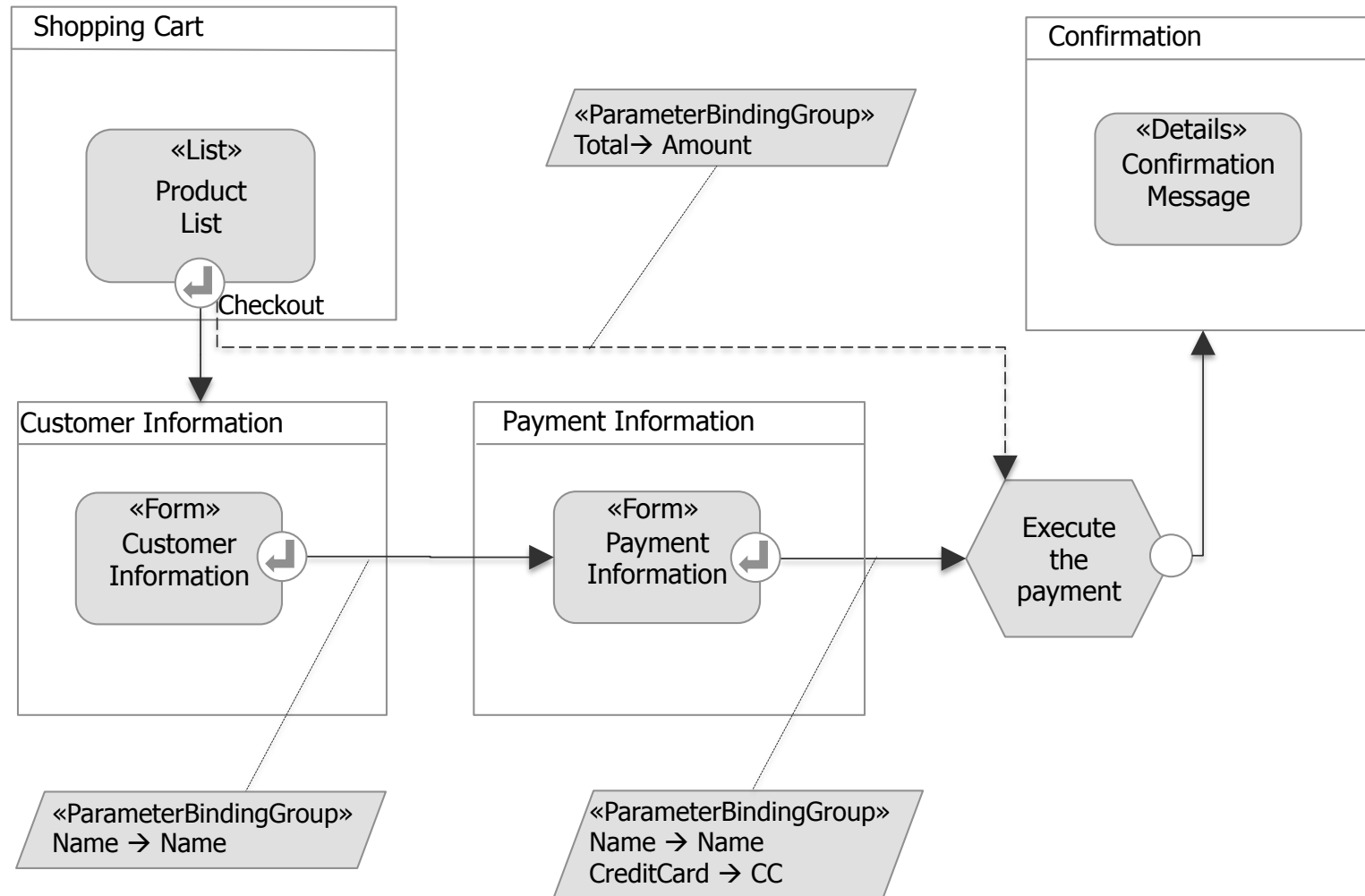


Additional examples and resources



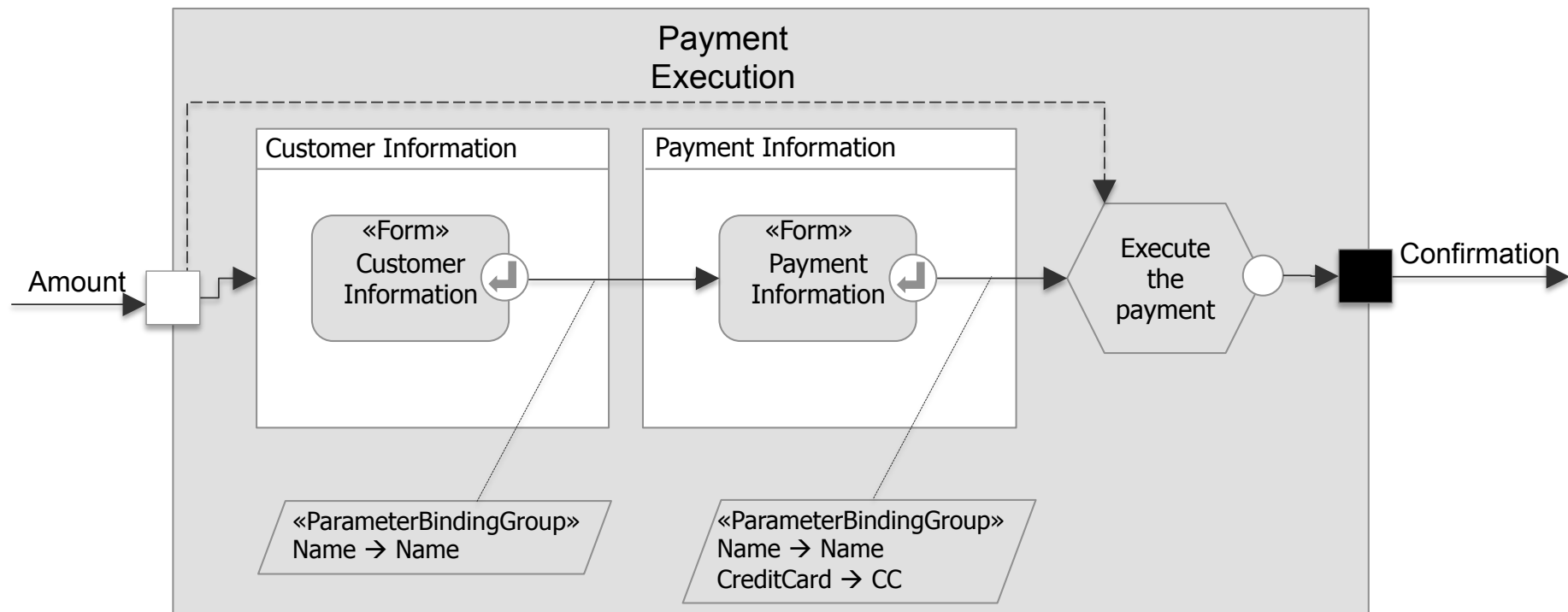


IFML example – online payment



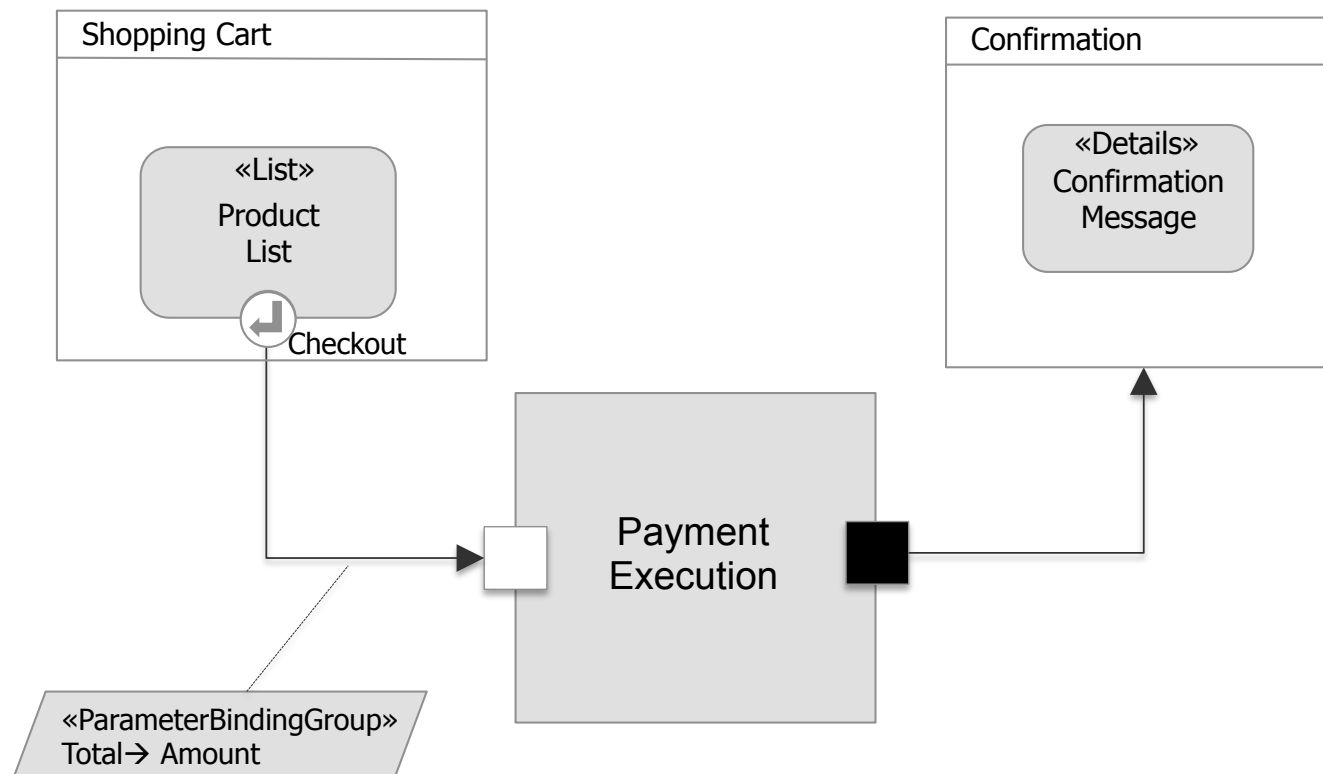


IFML concrete syntax – modules



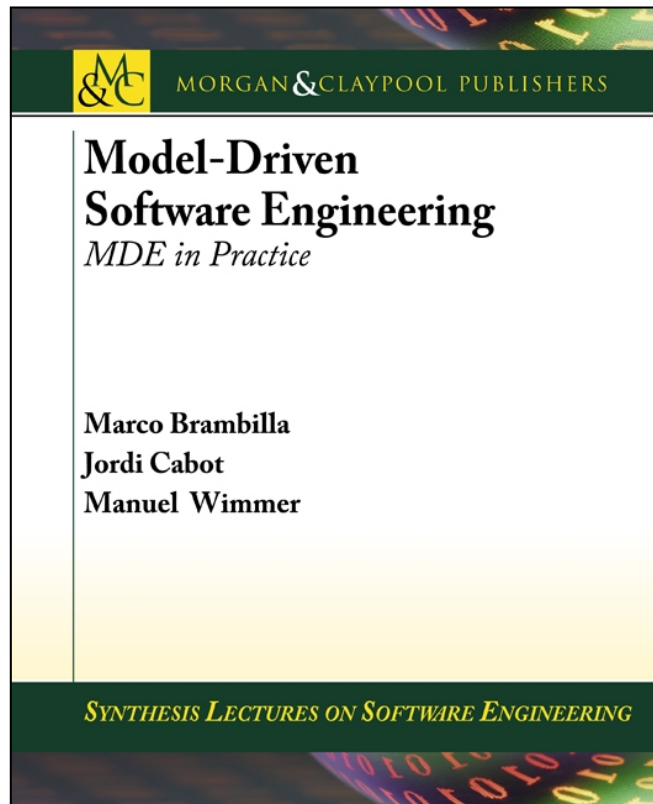


IFML concrete syntax – modules



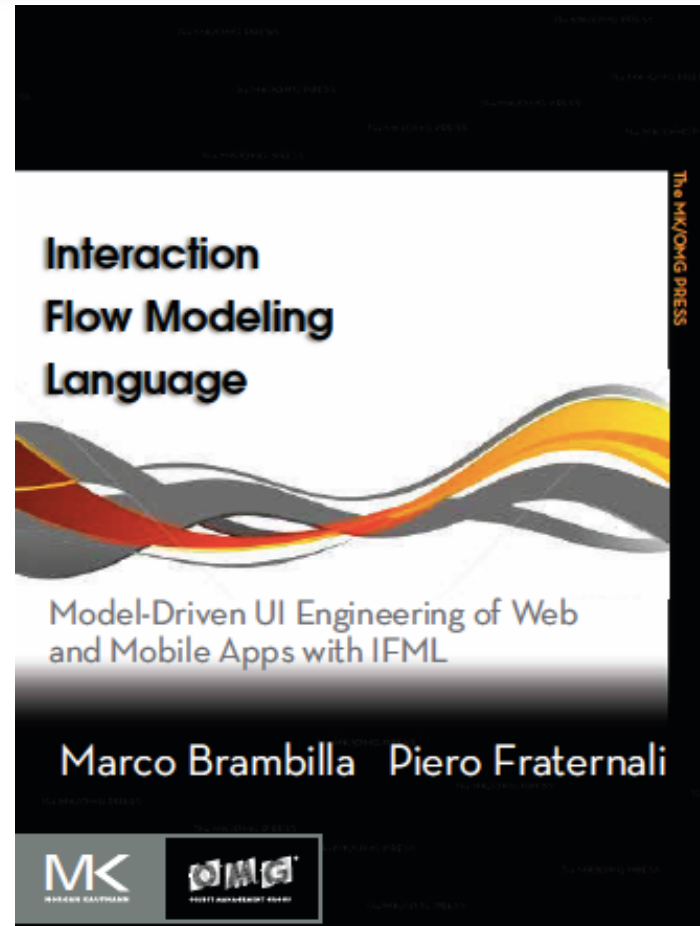


Some Ads



“Model Driven Software Engineering in Practice”.
Brambilla, Cabot, Wimmer.

Morgan&Claypool, USA, 2012



Interaction Flow
Modeling Language

Model-driven UI
Engineering of Web
and Mobile Apps
with IFML

Morgan Kaufmann,
The OMG press,
USA, Q4 2014