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Marcello Marconi, PhD

INDUSTRY 4.0

Technologies and Opportunities

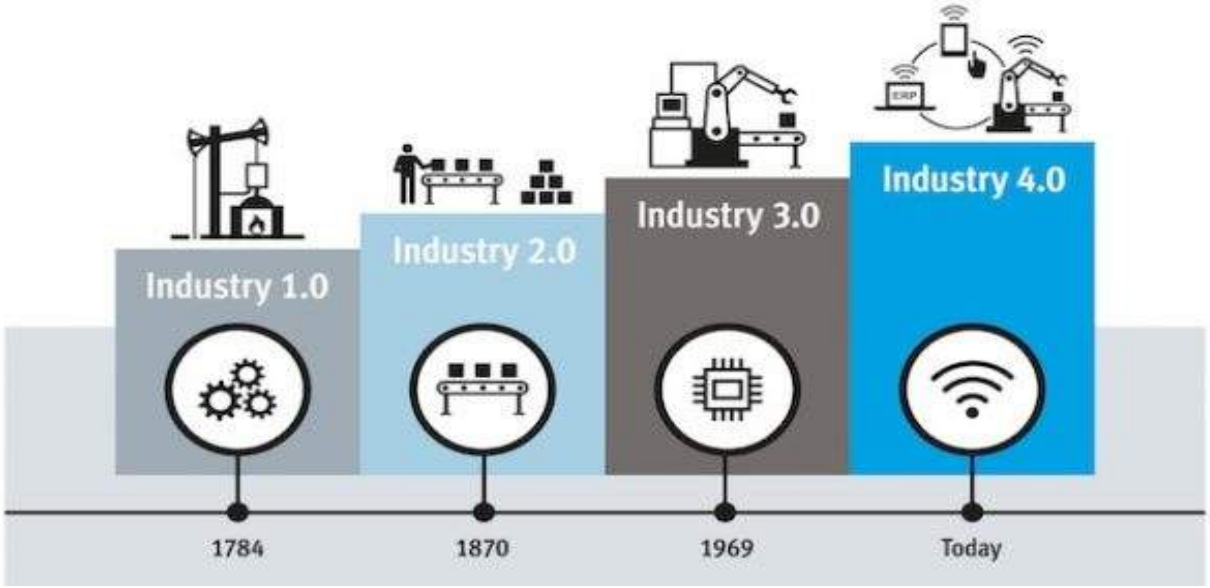
INDUSTRY 4.0 – DEFINIZIONE

2011 Fiera di Hannover ("Zukunftsprojekt Industrie 4.0" di Kagermann, Wolf-Dieter e Wahlster)

"Industria 4.0" rappresenta un modo di trasformare il funzionamento di intere catene del valore

- This definition is applied only if the subject is a **company,** not a "natural person"
- The first definition of Industry 4.0 was implemented for **manufacturing** industry. Now the concept is extended to every company: the (smart) Factory is **"…the physical place where value is generated**" (Services, vending machines, healtcare field…)

INDUSTRIA 4.0: QUARTA RIVOLUZIONE INDUSTRIALE



La forza La scala La velocità ?

INDUSTRY 4.0
TECNOLOGIE ABILITANTI

Digital data availability and Big Data Analytics: big data elaborations, low-cost, cloud computing, process virtualization, fast prototyping and AI

Robotics and advanced automation: costs, production errors and time reduction

High connectivity level: internet of things application in the value chain

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INDUSTRIA 4.0
DIRETTRICI DISTINTIVE

Interconnessione

Scambiare informazioni con sistemi interni (e.g. ERP, CRM systems, etc.) e/o esterni (clienti, fornitori, partners, supply chain, etc.)

Virtualizzazione

il digital twin del sistema reale per la previsione del comportamento mediante simulazione.

La combinazione dei component fisici e del digital twin è il modello cyber-fisico (riduzione di tempi e costi)

Decentralizzazione

I componenti cyber-fisici che costituiscono l'impianto di produzione dispongono di opportune strategie di autodiagnosi

Interazione da remoto: devices are remotely accessible. Information on the system behavior can be retrieved and corrective actions can be implemented

Real time elaborations and reactions: functions for real time data mining and implementation of reactions

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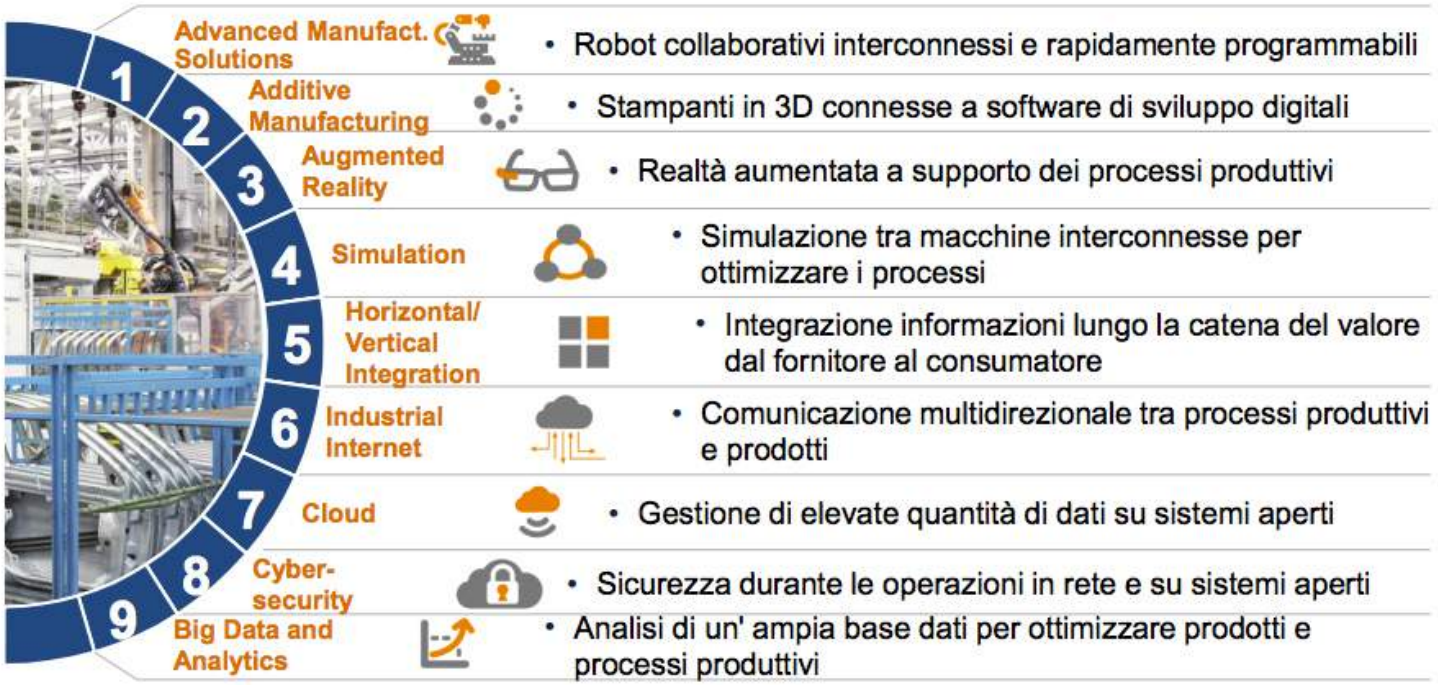
INDUSTRY 4.0 – KEY ENABLING TECHNOLOGIES (KET)



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INDUSTRY 4.0
IN EUROPA

In Italia, "Industria 4.0" è un **Piano Strategico Nazionale**

L'Italia presenta il **miglior scenario** europeo per investimenti in R&D e "Industria 4.0"

Sono definite condizioni ottimali di **re-shoring**

Nazione	Disciplina fiscale
Italia	Super-ammortamento beni materiali "Iper"-ammortamento beni materiali/immateriali "Industria 4.0"
Francia	"Iper"-ammortamento beni materiali "Industria 4.0"
Germania	No (approccio diretto)
Spagna	No
Olanda	Ammortamento rapido

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LO SCENARIO ITALIANO

INCENTIVI PER L'INNOVAZIONE

Super- e Iper-ammortamento

non sono detrazioni e non sono cumulabili con il credito d'imposta per attività di R&D

Possono essere combinate con altri tipi di contributo (POR-FESR, Sabatini…)

Credito d'imposta per attività di R&D

dal 25% al 50% dei costi sostenuti

Detrazioni/deduzioni per investimento in startup e PMI innovative

Dal 40% o 50% dell'investimento

Legge "Sabatini"

Contributo MiSE per investimenti 20 k€ - 4M€

2,75% investimenti "ordinary"
3,575% investimenti "Industria 4.0"

"Patent box"

tassazione agevolata di alcuni intangibles (I.P.)

Super-ammortamento

+30% del costo dei beni materiali (tangibles)

Iper-ammortamento

+170% per investimenti fino a 2.5 M€
+100% per investimenti da 2.5 M€ a 10 M€
+50% per investimenti da 10 M€ a 20 M€
+40% per investimenti SW (intangibles)

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LO SCENARIO ITALIANO

COMBINATO DI DISCIPLINE AGEVOLATIVE

Tema: Acquisto di macchinario innovative del valore di 1M€

Incentivi:

- POR FESR 2014-2020 "Bando PIA": contributo 30% in conto capitale
- Sabatini Ter: contributo 3,575% in conto interessi
- Iper-ammortamento: liquidità per mancata tassazione (IRES 24% su 170%)

Tutte le misure sono cumulabili

- POR-FESR: 30% (1 M€) = **300 k€**
- Legge Sabatini : 3,575% (1 M€) = **36 k€**
- Iperammortamento: 24% [170% (1 M€)] = 24% (1.7 M€) = **408 k€**

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LO SCENARIO ITALIANO

BENI MATERIALI AGEVOLABILI

I. Beni strumentali il cui funzionamento è controllato da sistemi computerizzati o gestito tramite opportuni sensori e azionamenti
    11. macchine, anche motrici e operatrici, strumenti e dispositivi per il carico e lo scarico, la movimentazione, la pesatura e la cernita automatica dei pezzi, dispositivi di sollevamento e manipolazione automatizzati, AGV e sistemi di convogliamento e movimentazione flessibili, e/o dotati di riconoscimento dei pezzi (ad esempio **RFID**, visori e sistemi di visione e meccatronici)

II. Sistemi per l'assicurazione della qualità e della sostenibilità

III. Dispositivi per l'interazione uomo macchina e per il miglioramento dell'ergonomia e della sicurezza del posto di lavoro in logica «4.0»

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THE ITALIAN SCENARIO – IPER-AMORTIZATION REQUIREMENTS (1)

The assets need to satisfy all the following 5 characteristics in order to be eligible to iper-amortization:

1. CNC (Computer Numerical Control) and/or PLC (Programmable Logic Controller) control
2. Inter-connection to IT systems and possibility of interaction with instructions or part program
3. Automatic integration with logistic system or with supply network and/or with other machines
4. Simple and intuitive frontends
5. High standards in safety, health and hygiene

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THE ITALIAN SCENARIO – IPER-AMORTIZATION REQUIREMENTS (2)

Furthermore the assets need to satisfy at least 2 of the following 3 characteristics:

1. Remote maintenance systems and/or remote diagnosis and/or remote control
2. Continuous condition monitoring through appropriate sensors and adaptivity to the process evolution
3. Cyber-physics systems: integration between physical assets and behavior simulation during process evolution

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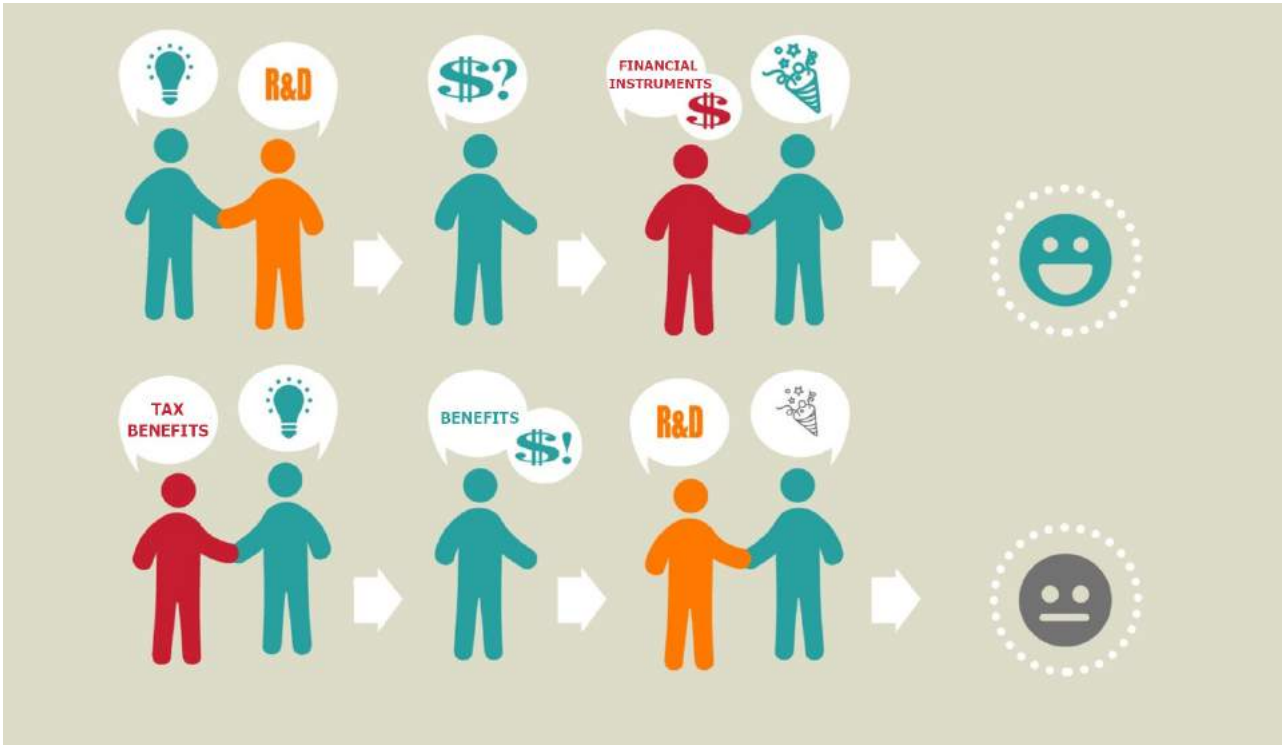
INDUSTRY 4.0 – VIRTUOUS INVESTMENTS STRATEGIES



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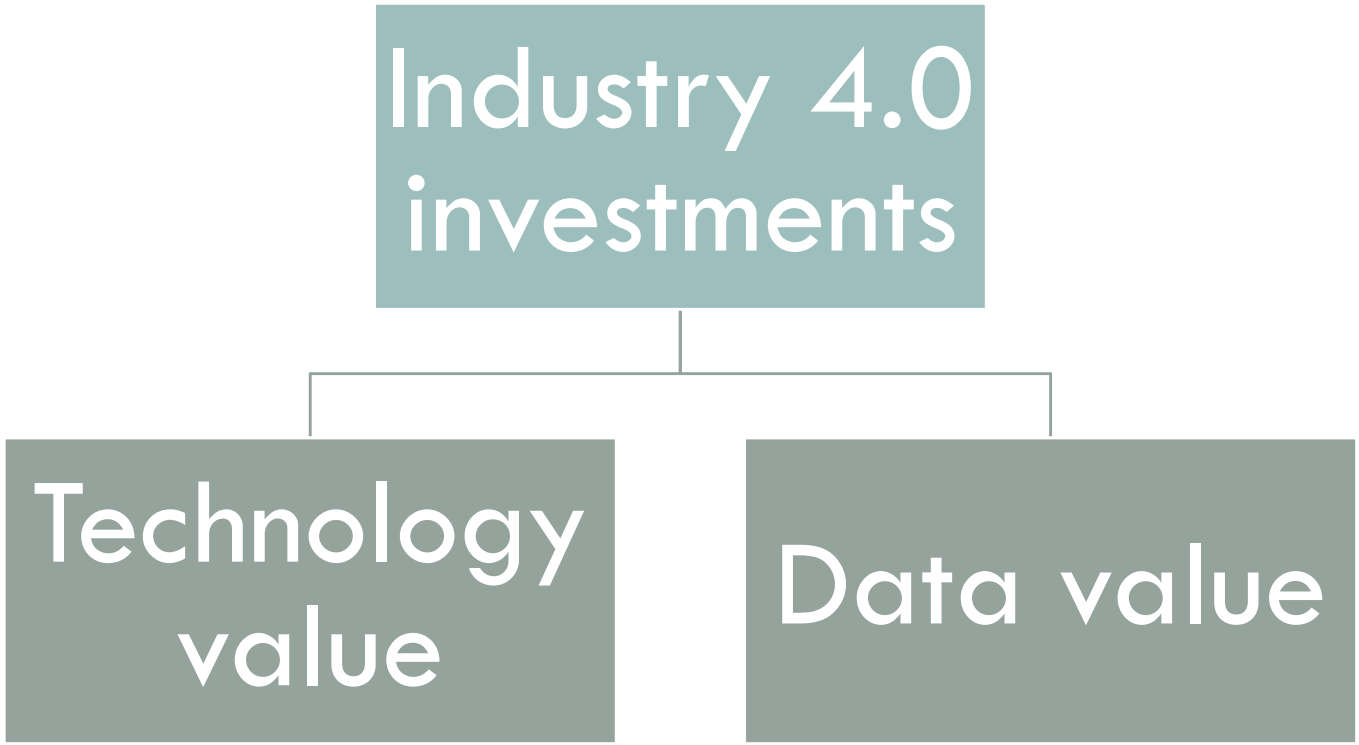
INDUSTRY 4.0 – VALUES FOR COMPANIES



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INDUSTRY 4.0 – TECHNOLOGY VALUE: OBJECTIVES

With Industry 4.0 technology it is possible to achieve the following objectives:

- **Flexibility**: possibility of small quantities productions with the same costs of large scale production
- **Velocity** in prototyping and mass production with new technologies and low set-up and goto-market time
- **Productivity** through costs and waste reduction (defects and errors detection); reliability and quality increase
- **Integration** of supply chains with logistic and supplying systems improvements
- **Safety**: errors and accident reduction, better ergonomics and work quality conditions
- **Sustainability**: energy, raw materials consumption and polluting emission reduction
- **Product innovation**: new digital technologies allows to develop new business models based on smart products

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INDUSTRY 4.0 – TECHNOLOGY VALUE: IMPLEMENTATION

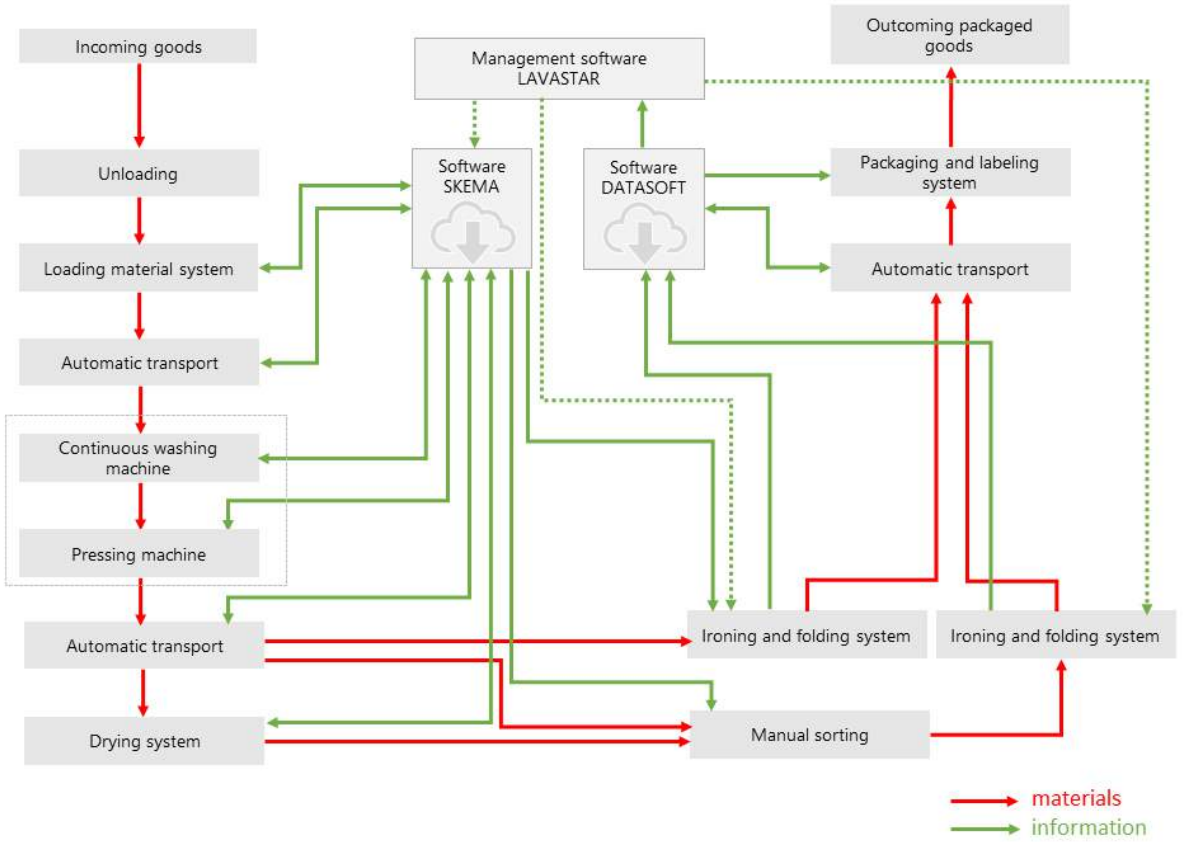
Interconnection system improves the global productivity with the reduction of time to market, error minimization and quality enhancement

Interconnection system can be implemented in two ways:

- **Central software interconnection**: every machine transmit information to the central control software; the material handling is controlled by the central information control
- **Machine-to-machine (M2M) interconnection**: every machine transmit information to the next machine in the supply chain; the material handling is controlled at every step from information flux between the machines

INDUSTRY 4.0 – TECHNOLOGY VALUE: THE LAUNDRY EXAMPLE

CENTRAL SOFTWARE INTERCONNECTION



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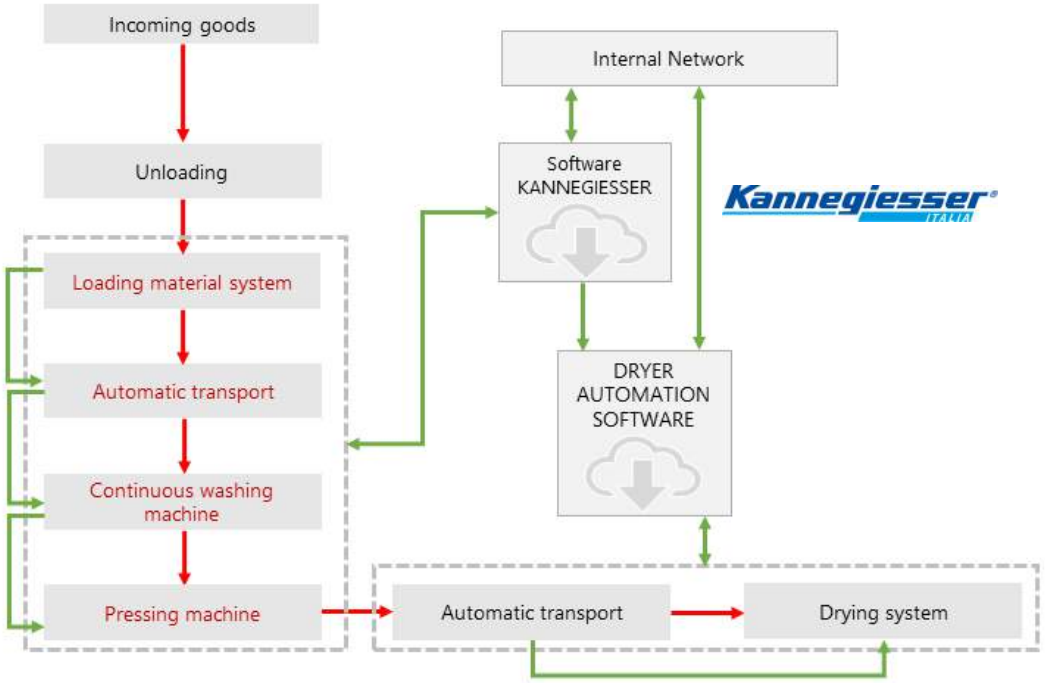
INDUSTRY 4.0 – TECHNOLOGY VALUE: THE LAUNDRY EXAMPLE

M2M INTERCONNECTION



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INDUSTRY 4.0 – TECHNOLOGY VALUE: THE LAUNDRY EXAMPLE

CONTINUOUS WASHING MACHINE

Kannegiesser ITALIA

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INDUSTRY 4.0 – TECHNOLOGY VALUE: THE LAUNDRY EXAMPLE

PLC SYSTEM

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INDUSTRY 4.0 – THE LAUNDRY EXAMPLE

ETHERNET INTERCONNECTION SYSTEM

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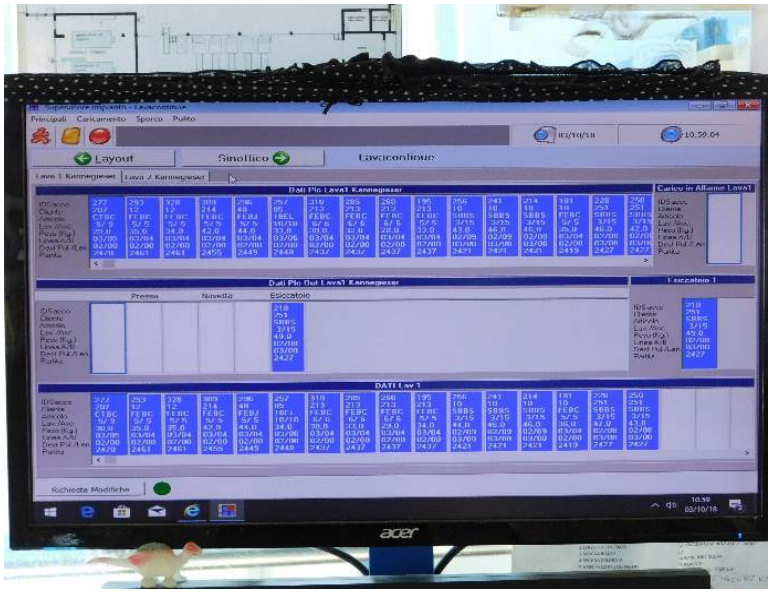
INDUSTRY 4.0 – TECHNOLOGY VALUE: THE LAUNDRY EXAMPLE

MONITORING

Bag emptying monitoring with software *Skema*



PLC data monitoring

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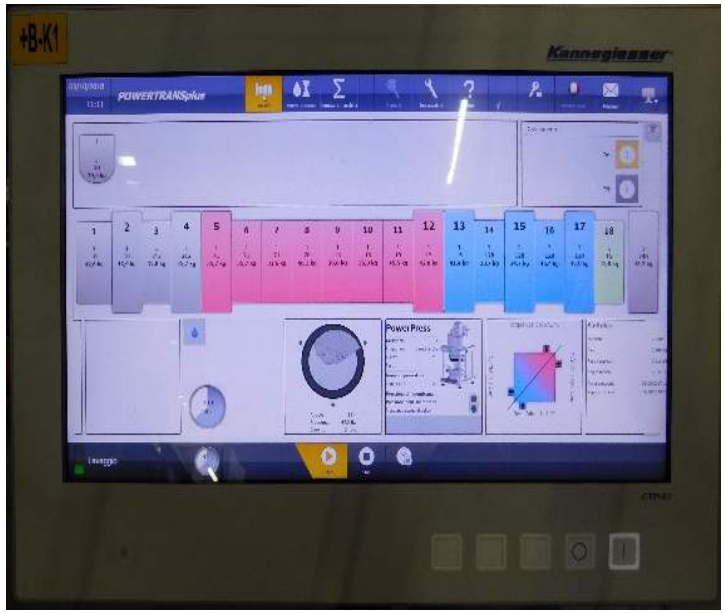
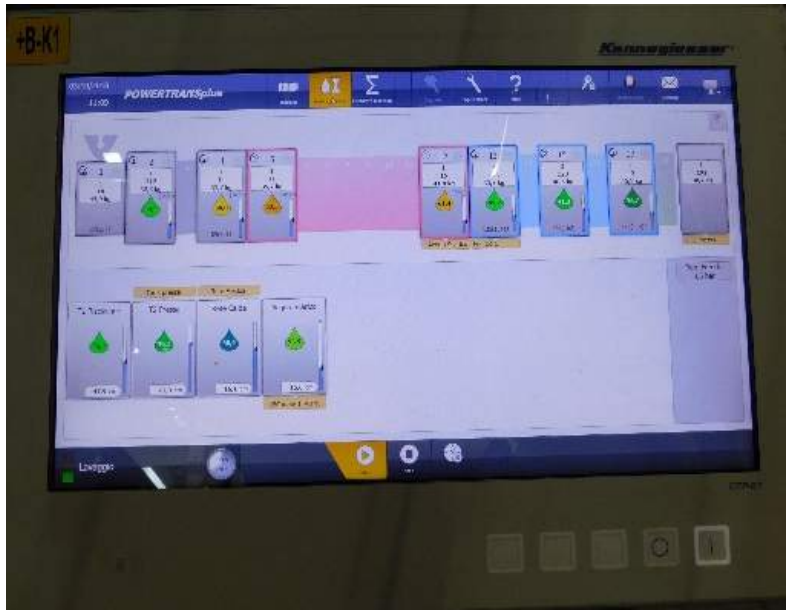
INDUSTRY 4.0 – TECHNOLOGY VALUE: THE LAUNDRY EXAMPLE

USER INTERFACE

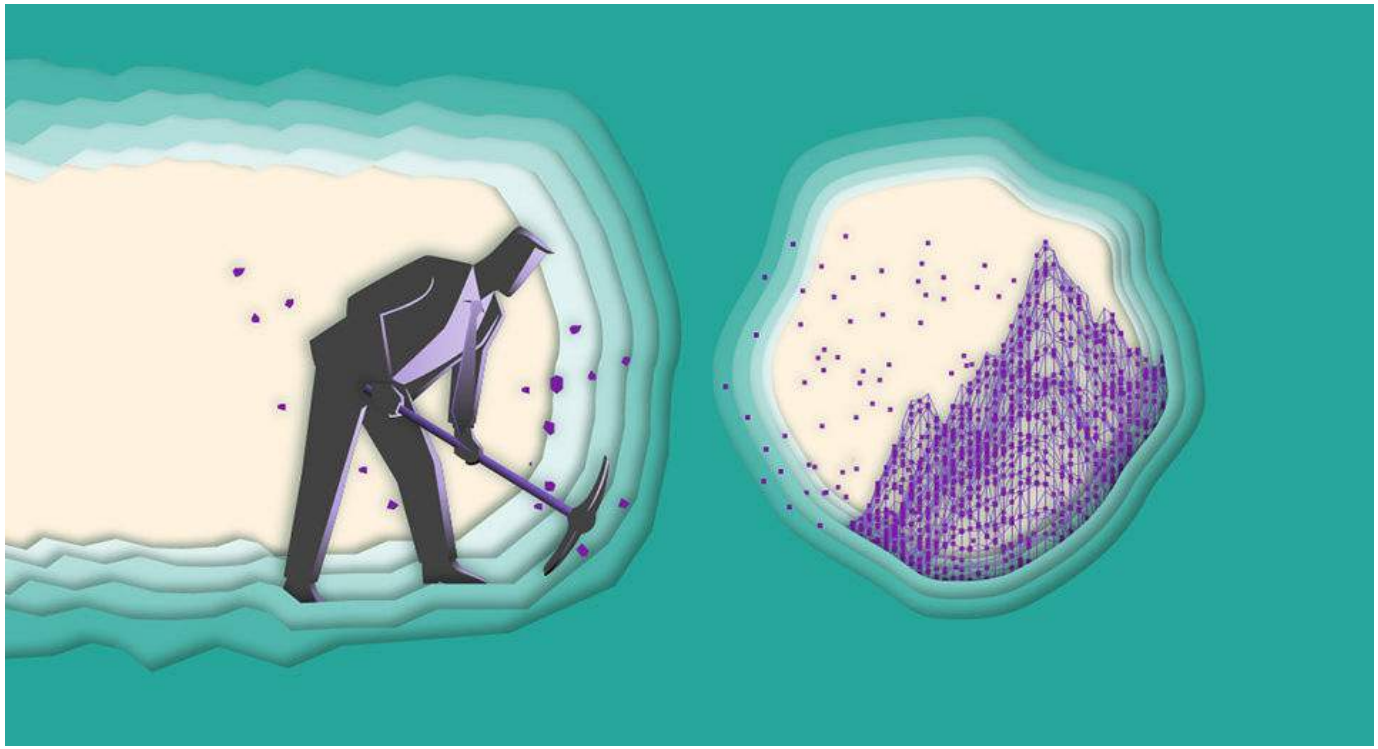


Work process evolution



Work process details

INDUSTRY 4.0 – DATA VALUE



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INDUSTRY 4.0 – DATA VALUE: DSS EXAMPLE

Case study: Wide area with complex orography and high density human presence

The problem: Rainfall and water flux forecast in order to avoid flood

Physical systems: Sewerage system with sensors, pluviometers, water level sensors

Cyber physical system: Hydrological and weather simulations

With data from sensors and simulations is possible to develop a DSS system

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INDUSTRY 4.0 – DATA VALUE: DSS EXAMPLE

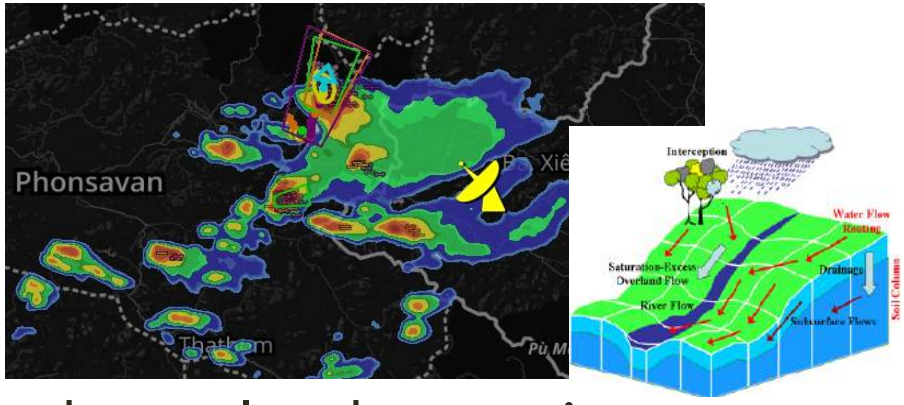
FLOOD CONTROL AND PREVENTION

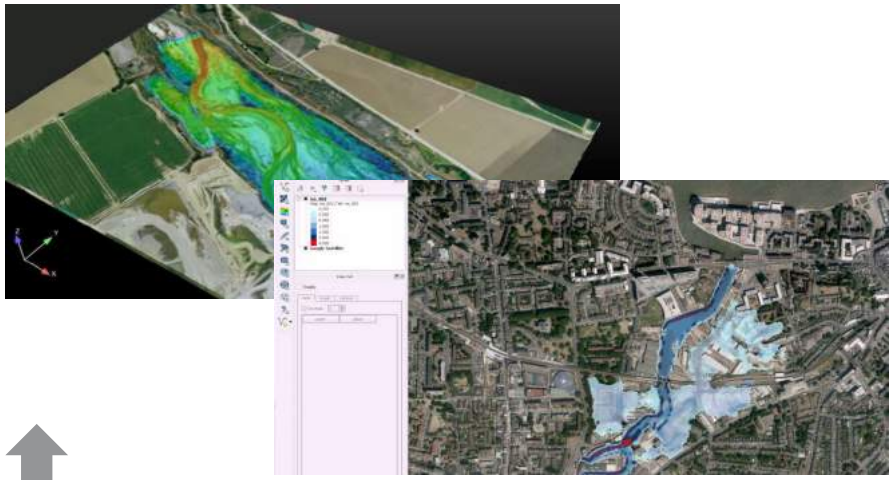
Flood control and prevention

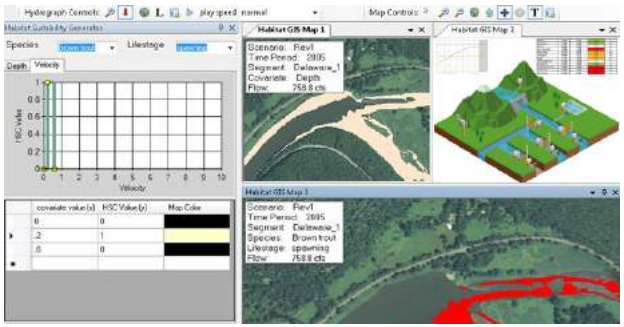
Based on weather monitoring and nowcasting, a combination of physical, black box and GIS models is used to estimate the upcoming discharges and simulate the flooded areas

INDUSTRY 4.0 – DATA VALUE: DSS EXAMPLE

FLOOD CONTROL AND PREVENTION





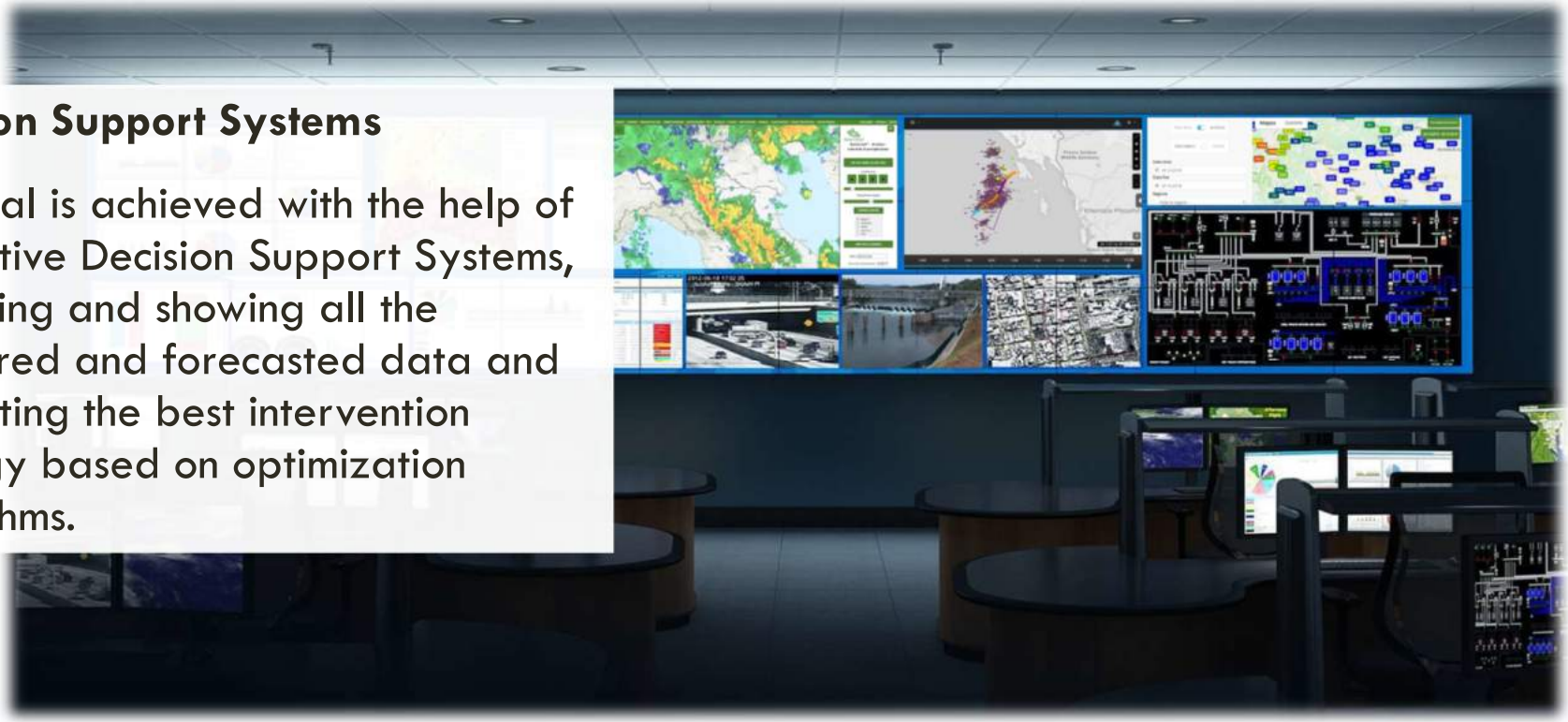


Flood control and prevention

The data provided by the weather monitoring system and the user's network feed the hydraulic/hydrological models. Following the exceeding of alert levels related to possible flooding scenarios, the DSS suggests the best mitigation strategies (close / open gates, etc.)

INDUSTRY 4.0 – DATA VALUE: DSS EXAMPLE

FLOOD CONTROL AND PREVENTION



Decision Support Systems

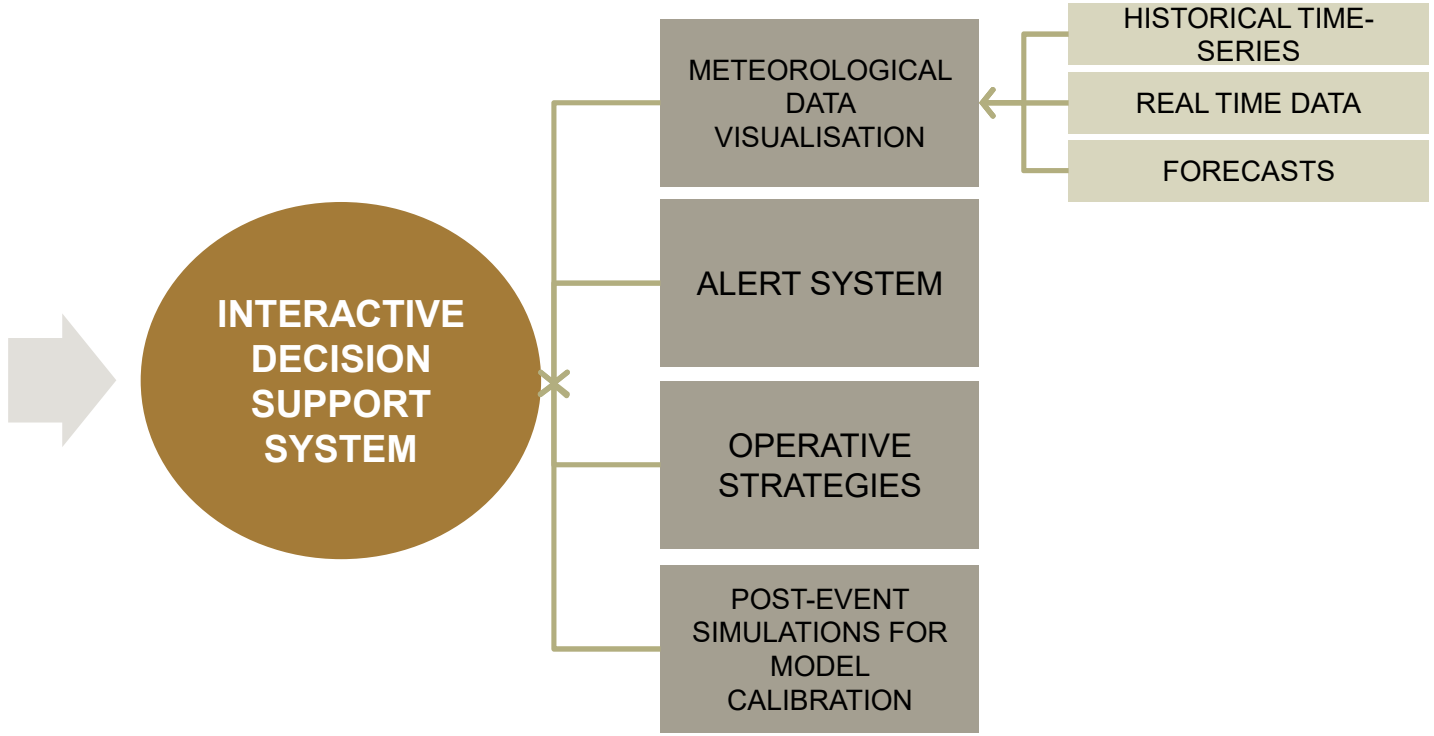
The goal is achieved with the help of interactive Decision Support Systems, receveing and showing all the monitored and forecasted data and suggesting the best intervention strategy based on optimization algorithms.

INDUSTRY 4.0 – DATA VALUE: DSS EXAMPLE

INTERACTIVE DECISION SUPPORT SYSTEM

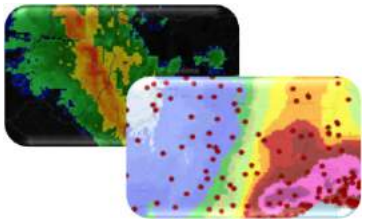
GOALS

- NETWORK/SYSTEM BEHAVIOUR ANALYSIS
- HISTORICAL EVENTS SIMULATION AND REANALYSIS
- AUTOMATED DECISION SUPPORT SYSTEM DESIGN
- REAL TIME STRATEGIES PLANNING BASED ON FORECAST MODELS

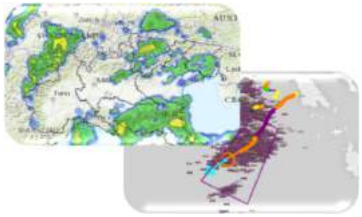


INDUSTRY 4.0 – DATA VALUE: DSS EXAMPLE

OPERATIVE TOOLS



WEATHER DATA COLLECTION FROM GROUND GAUGES AND RADARS

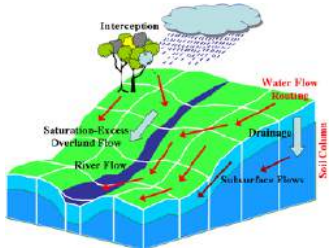


NOWCASTING FROM INNOVATIVE MODELS

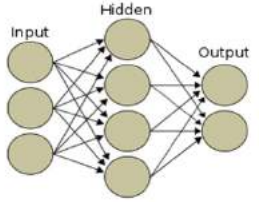
SCADA DATA COLLECTION

DSS

HYDRAULIC/ HYDROLOGICAL MODELS



BLACK BOX MODELS



OPTIMISATION ANALYSIS