

Desenvolupament i producció local de mínims productes viabls d'Internet de les coses

<https://www.eic.cat/jornades/1123937>

Mínims productes viabls i prototips virtuals amb Low-Code i bessons digitals populars de hardware

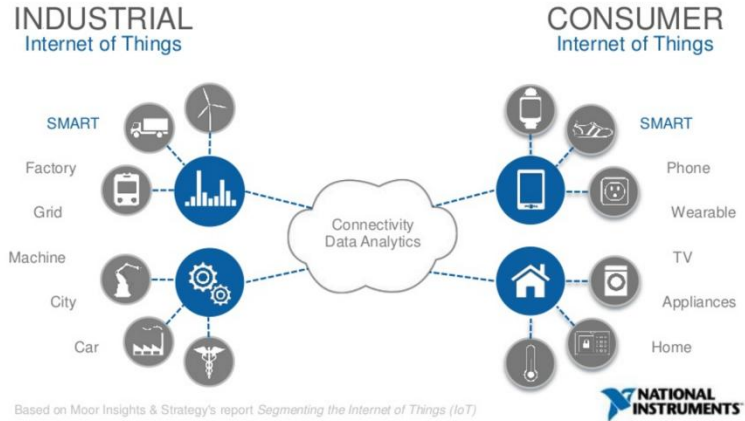
Xavier Pi

Vicepresident GT IoT & Embedded Systems

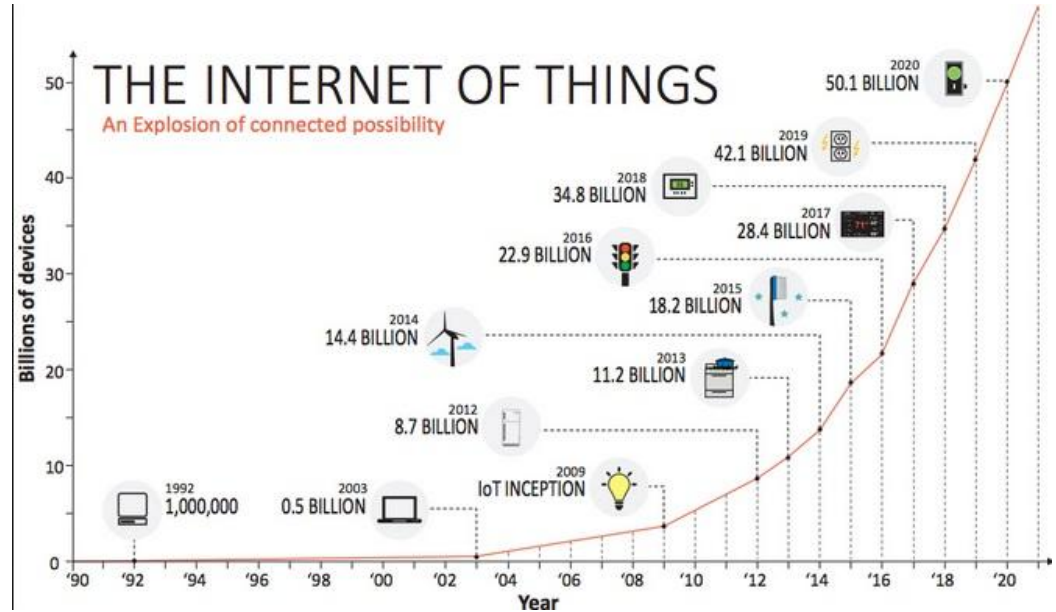
Comissió Indústria 4.0 Enginyers de Catalunya

www.linkedin.com/in/xavierpi

La Internet de les coses (IoT o IIoT)

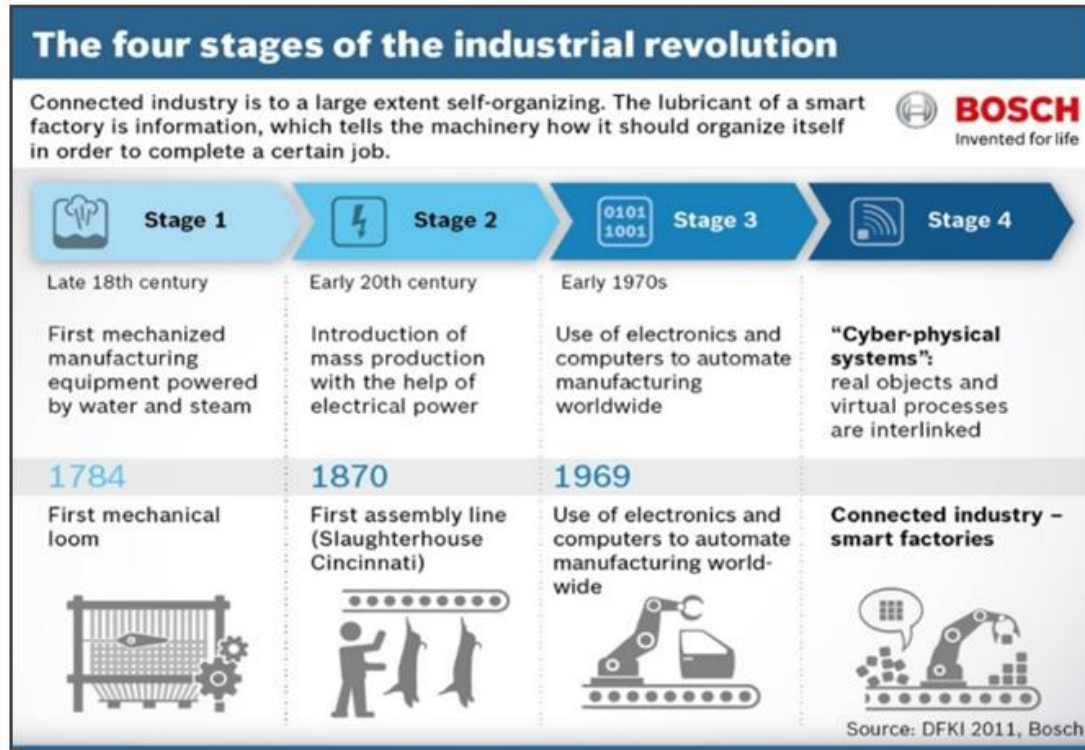


La IoT connecta coses, com dispositius, simuladors o models en general



Font: Basat en gràfic de Cisco Systems

La Quarta revolució industrial (Indústria 4.0)



Moviments paral·les de DIY amb impacte directe sobre el món no professional de totes les edats (voluntat de trencar barreres):

- *Popular Mechanics* (1902)
- Meccano (1898)
- *PC Magazine* (1982), *PC World* (1983)
- Apple II (1977), IBM PC (1981), Sinclair Spectrum (1982)
- *Make: (magazine)* (2005)
- Arduino (2008), ESP32 (2015), Raspberry Pi (2012)

Impacte sobre la recerca

[Published: 06 April 2017](#)

The DIY electronics transforming research

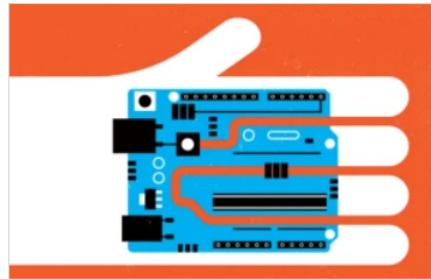
[Daniel Cressey](#)

[Nature](#) **544**, 125–126 (2017) | [Cite this article](#)

537 Accesses | **34** Citations | **336** Altmetric | [Metrics](#)

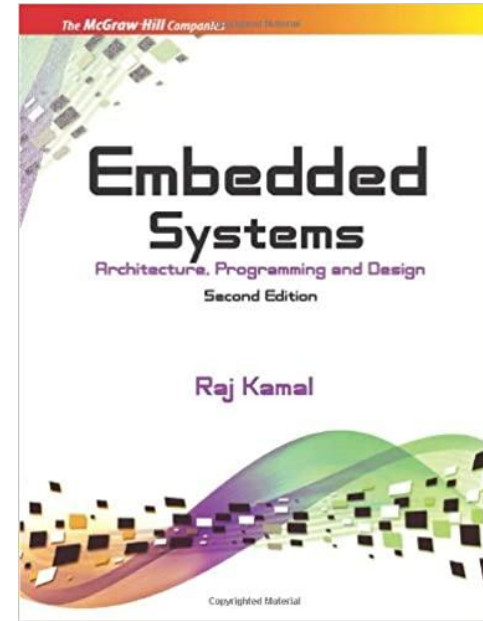
Cheap, stripped-down microcontrollers are allowing users to pack huge amounts of computing power into tiny spaces.

www.nature.com/articles/544125a



Classificació dels Embedded Systems

- A l'any 2014 el GT va adoptar la classificació del professor Raj Kamal dels Embedded Systems:
 - Escala petita (Arduino)
 - Escala mitjana (ESP32)
 - Escala sofisticada (Raspberry Pi)

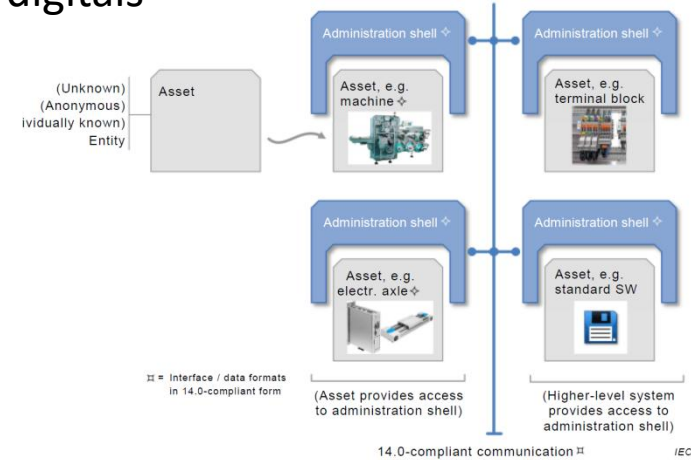
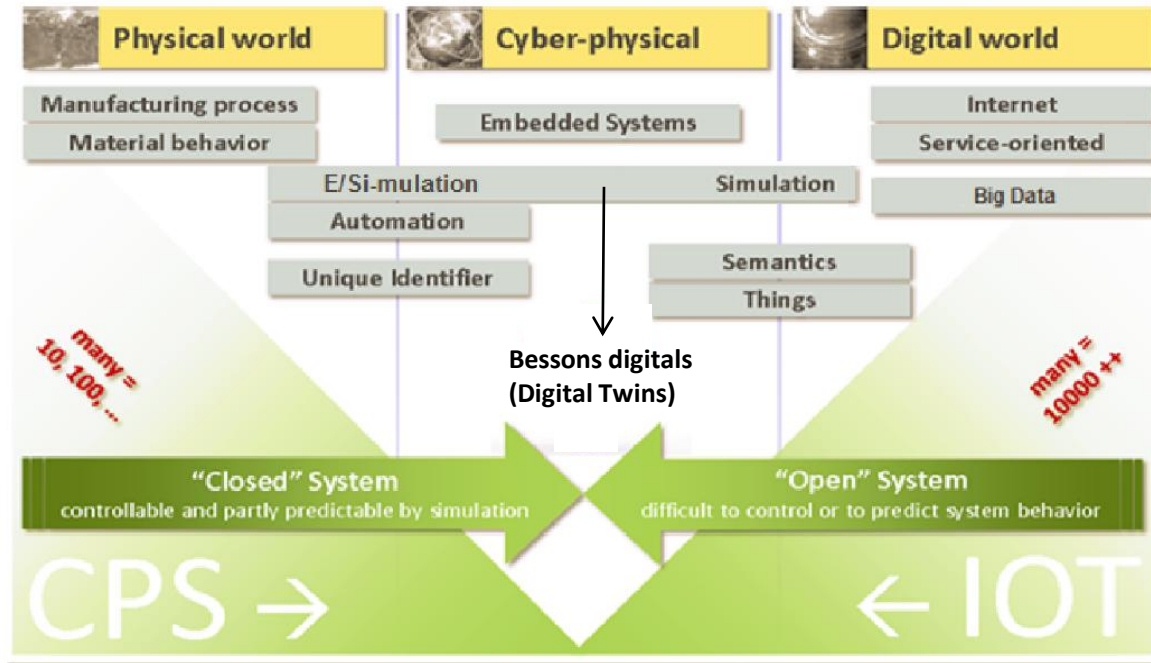


Elements centrals dels sistemes ciberfísics

The way so far and beyond

Two Worlds coming together

Sistemes embebats i bessons digitals



Arquitectura (visió OT):

RAMI 4.0 (Reference Architecture Industry 4.0)
Standard IEC/PAS 63088

Arquitectura (visió IT):

IIRA (Industrial Internet Reference Architecture)
Estandaritzat les nocions de **Cloud** i **Edge**

Terminologia sobre bessons digitals:

www.digitaltwinconsortium.org/glossary

Digital Twin i la seva evolució

(Michael Grieves 2002)



*Dr. Michael Grieves and John Vickers – University of Michigan

Emergència del Low-Code

Combining low-code programming and SDL-based modeling with snap! in the industry 4.0 context

Pi Palomés, Xavier
Tuset Peiro, Pere
Fonseca Casas, Pau   

Tipus de document: Text en actes de congrés

Data publicació: 2021

Conditions d'accès: Accès ouvert

Abstract

One of the main challenges to implement Industry 4.0 technologies within the industrial fabric is the lack of suitable concrete models and tools that demonstrate the potential benefits of embracing the digital transformation process. To overcome this challenge, over the past years, various Industry 4.0 automation and robotics providers have presented solutions based on visual block programming languages, which follow an emerging low-code approach to reduce the entry barriers of digital technologies. However, block-based low-code tools typically lack the formality introduced by specification... [4]

Descripció

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Comissió Indústria 4.0 – Enginyers de Catalunya



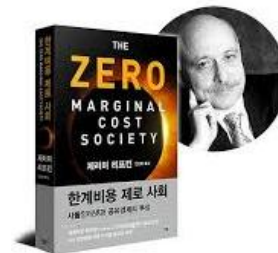
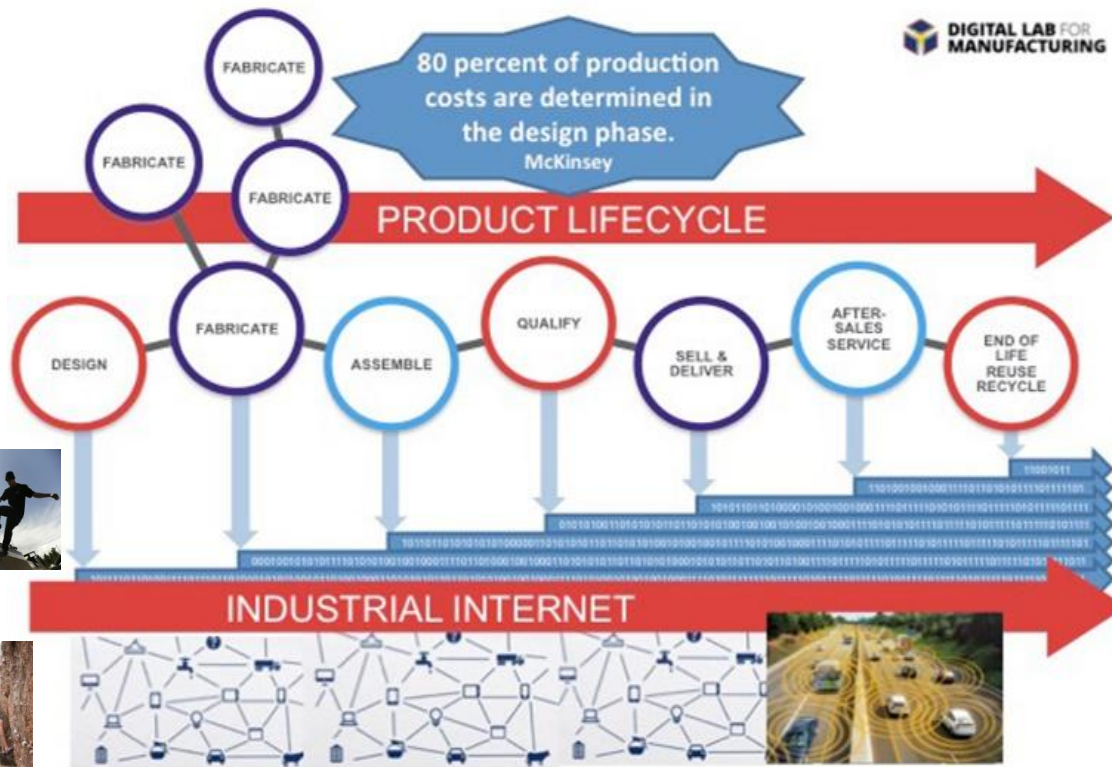
Visualitza/Obre

 Main article (964,4Kb)

Commentaire:

Cicle de vida i cadena de valor digital

DIGITAL LAB FOR
MANUFACTURING



Jeremy Rifkin



Digital Twin

Bessons digitals en línia per al desenvolupament de sistemes IoT

- Tinkercad
 - www.tinkercad.com
- Wokwi
 - www.wokwi.com
- Infineon (TinaCloud)
 - <https://design.infineon.com/tinademo/tina.php>

Tinkercad (I)

tinkercad.com/things/bh9baKEivhw-practica-ldr/editel

Práctica LDR

Se han guardado todos los cambios.

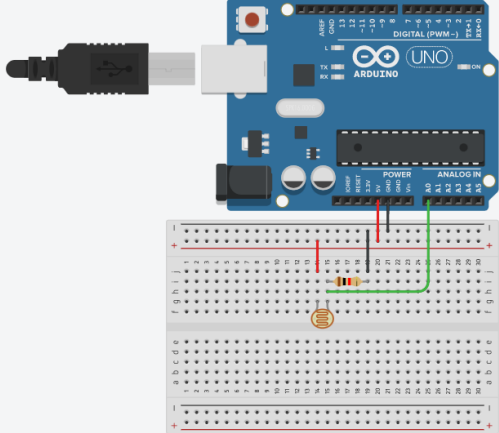
Código Iniciar simulación Enviar a

Bloques

- Salida
- Entrada
- Notación
- Control
- Matemáticas
- Variables

1 (Arduino Uno R3)

<https://didactronica.com/niveles-de-luz-con-fotorresistencias-ldr>



```
definiir LED integrado en ALTA
definiir pasador 0 en ALTA
definiir pasador 3 en 0
girar servo en el pasador 0 a 0
reproducir altavoz en el pasador 0 con
desactivar el altavoz en pasador 0
imprimir en monitor en serie hello world
definiir LED RGB de pines 3 3
```

repetir mientras 1 = 1

definir luminosidad en leer pasador analógico

esperar 500 milisegundos

imprimir en monitor en serie luminosidad

Monitor en serie

Tinkercad (II)

tinkercad.com/things/bh9baKEivhw-practica-ldr/editel

Práctica LDR

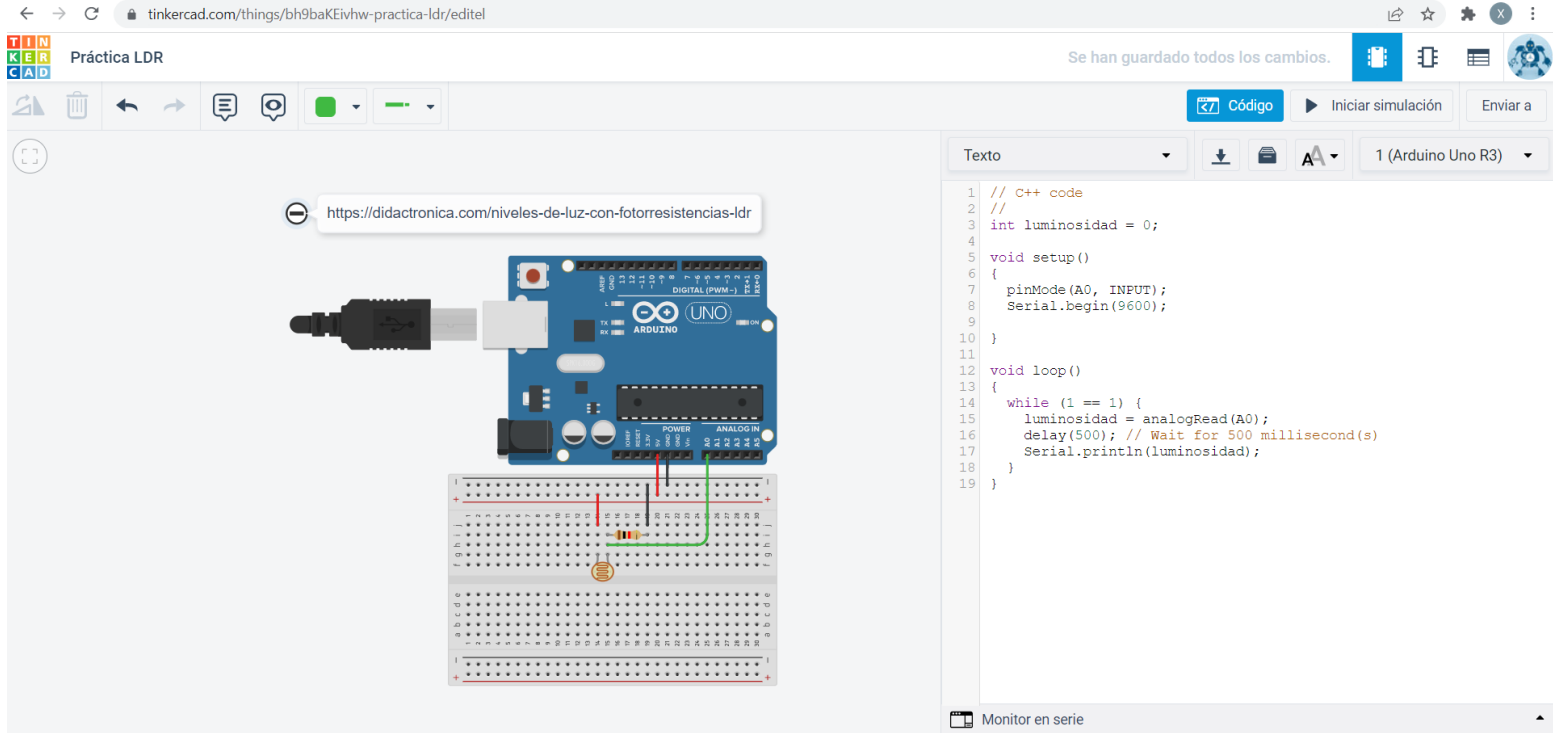
Se han guardado todos los cambios.

Código ▶ Iniciar simulación Enviar a

Texto 1 (Arduino Uno R3)

```
1 // C++ code
2 //
3 int luminosidad = 0;
4
5 void setup()
6 {
7   pinMode(A0, INPUT);
8   Serial.begin(9600);
9
10 }
11
12 void loop()
13 {
14   while (1 == 1) {
15     luminosidad = analogRead(A0);
16     delay(500); // Wait for 500 millisecond(s)
17     Serial.println(luminosidad);
18   }
19 }
```

Monitor en serie



Wokwi

← → ↺ wokwi.com/arduino/projects/324549436880454228

WOKWI SAVE SHARE

Docs

sketch.ino diagram.json PubSubClient.h PubSubClient.cpp Library Manager

```
1 |
2 // From https://randomnerdtutorials.com/esp32-mqtt-publish-subscribe-arduino-ide
3
4 #include <WiFi.h>
5 #include "PubSubClient.h"
6
7 const char* ssid = "Wokwi-GUEST";
8 const char* password = "";
9 const char* mqttServer = "broker.emqx.io";
10 int port = 1883;
11 String stMac;
12 char mac[50];
13 char clientId[50];
14
15 WiFiClient espClient;
16 PubSubClient client(espClient);
17
18 const int ledPin = 2;
19
20 void setup() {
21   Serial.begin(115200);
22   randomSeed(analogRead(0));
23
24   delay(10);
25   Serial.println();
26   Serial.print("Connecting to ");
27   Serial.println(ssid);
28
29   wifiConnect();
30
31   Serial.println("");
32   Serial.println("WiFi connected");
33   Serial.println("IP address: ");
```

Simulation

▶ + ⋮

<https://wokwi.com/arduino/projects/324549436880454228>

Gràcies !

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