PROGRAMMAZIONE INTERFACCE 21/22

DANIELE MAZZEI

Who, When and Where

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- Remote lectures streaming via Microsoft Teams via Google Meet, link on esami.unipi.it or HERE
- Teaching material shared via Google Classroom, link on esami.unipi.it or HERE
- Facebook page where I publish curiosities, news etc. HERE
- Office hours (mainly via remote call): Monday 11:00-13:00 (30 min slots). Max 2 students per slot via Google Meet (link available in the booked calendar event), book your slot HERE

Books and other material

- La caffettiera del masochista. Il design degli oggetti quotidiani – Donald A. Norman
  - [english] The Design of Everyday Things

- Designing the User Interface: Strategies for Effective Human-Computer Interaction, Global Edition - Ben Shneiderman [english only]

- Human Computer Interaction, L. Gamberini, Pearson

- Web: https://www.usability.gov/ and https://interaction-design.org

- Classroom GDrive for Slides
- Dispense (ITA, non complete) QUI
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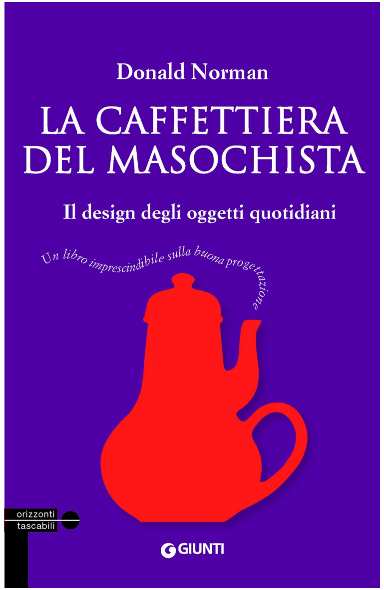


Exam

[6 CFU] = Written final exam (online quiz)

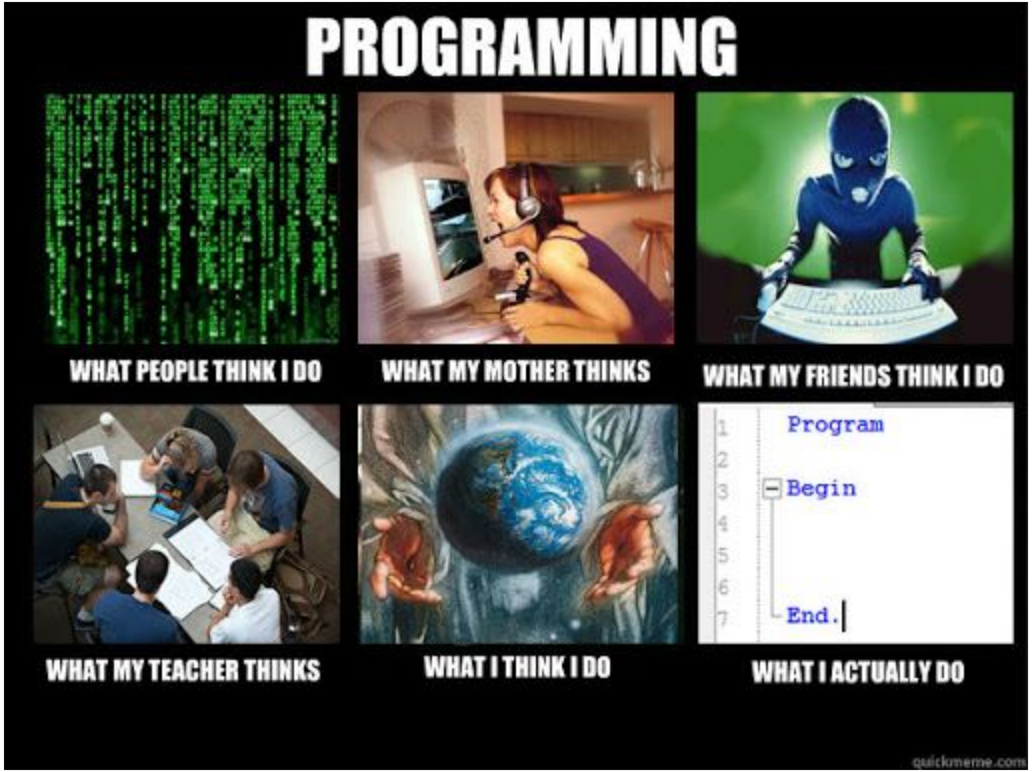
[9 CFU] = Written final exam (online quiz) + 3CFU Project

INTRO
UNA NUOVA ERA

Una nuova era

Negli ultimi anni il ruolo degli informatici è decisamente cambiato.

Per anni l'informatico è stato chiuso in uno sgabuzzino ad interagire in solitudine con una tastiera, bevendo bibite gassate mentre qualcuno gli diceva che cosa serviva (o almeno era convinto di sapere cosa servisse) all'azienda per crescere.



Obiettivo del corso

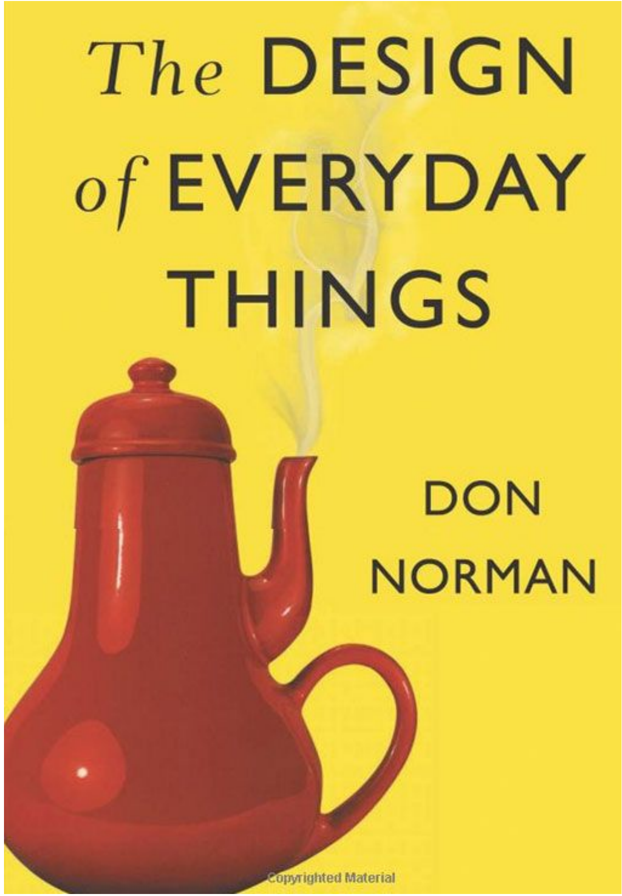
Questo corso è una trattazione adattata per informatici delle teorie di **human computer (HCI) e human machine interaction (HMI)** [interazione uomo-computer e interazione uomo-macchina].

L'obiettivo di questo corso è quindi quello di fornire agli studenti del corso di laurea in Informatica <u>gli strumenti necessari a comprendere e gestire il processo di sviluppo delle interfacce e dei prodotti interattivi.</u>

Questo corso ambisce a spostare l'informatico dal suo tipico ruolo di sviluppatore elevandolo quindi a progettista non solo del “codice” ma dell'intero prodotto.

Progettare l’interazione

Questo corso è ispirato alla teoria dell'interazione sviluppata dal Prof. Donald Norman ed in particolare, queste dispense sono in parte un adattamento didattico del libro “La caffettiera del masochista” di Donald Norman, pubblicato in Italia da Giunti e disponibile in lingua originale come “The design of everyday things, D. Norman”.



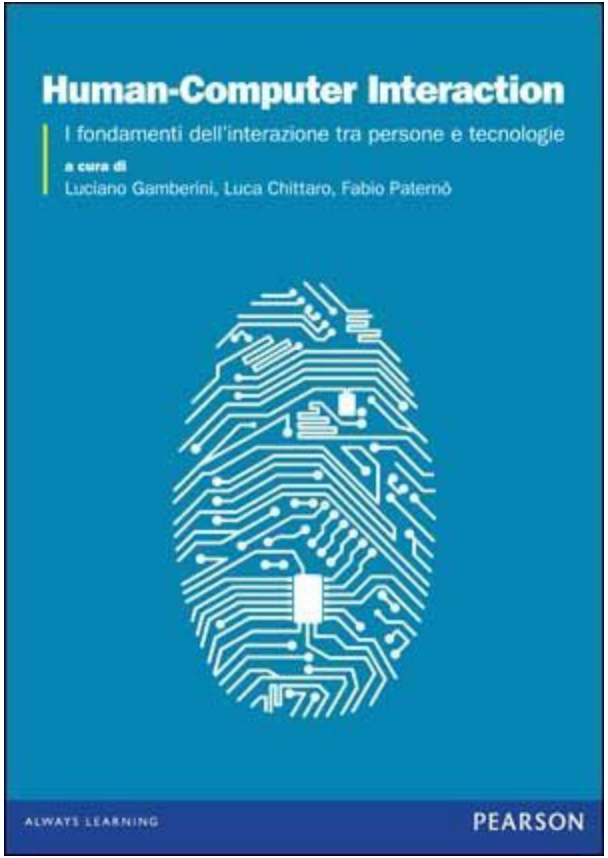
Progettare l'interazione

Nel corso verranno trattati anche aspetti relativi all'Internet delle cose e alle interazioni con robot e altri sistemi “smart”.

Questi aspetti legati all'interazione con oggetti smart sono anch'essi ispirati agli studi di Norman e sono ampiamente trattati nel libro “Il Computer Invisibile, D. Norman”, pubblicato in Italia da Apogeo.

Progettare l’interazione

Per quanto riguarda invece Usabilità e Dispositivi per l’Interazione è consigliato il libro “Human-Computer Interaction, I fondamenti dell'interazione tra persone e tecnologie”, L. Gamberini, Pearson.



Il Prodotto

Nel corso parlerò spesso di prodotto, business, acquisto e altri termini legati al mondo della vendita, dell'economia e del mercato.

Questo perché l'informatico deve sviluppare una consapevolezza fondamentale per il suo lavoro:

Un prodotto che nessuno compra è un prodotto inutile

Non importa quanto geniale sia il codice che avete scritto o rivoluzionario il sistema che avete implementato, se non vi curerete di far si che questo artefatto venga apprezzato e quindi utilizzato dalle persone la vostra creazione, geniale o stupida che sia, morirà dentro il vostro computer.

Progettare l'Interazione fra Uomo e Macchina

Design

La rivoluzione tecnologica degli ultimi anni ha portato a parlare molto di User Experience Design, User Interface Design, Interaction Design etc.

Cosa si intende con il termine Design?

Da Treccani.it: design s. ingl. [propr. «disegno, progetto», dal fr. dessein, che a sua volta è dall'ital. disegno], usato in ital. al masch. – Nella produzione industriale, progettazione (detta più precisamente industrial design) che mira a conciliare i requisiti tecnici, funzionali ed economici degli oggetti prodotti in serie, così che la forma che ne risulta è la sintesi di tale attività progettuale; quando la forma dell'oggetto viene elaborata indipendentemente dalla progettazione vera e propria, si parla più propriam. di styling design.

Design

In Italiano tendiamo quindi ad usare il termine design per riferirci sia al processo di progettazione che al risultato stesso di questo processo

- **Processo:** *“E' stato avviato il design dell'interfaccia grafica”*
- **Risultato del processo:** *“Ecco il design dell'interfaccia grafica pronto per essere implementato”*

Per design si intende quindi sia il processo di progettazione e pianificazione che l'output stesso di questo processo

Può un informatico diventare designer?

E' importante notare che nel mondo del design, ed in particolare nel design industriale, si approccia alla risoluzione dei problemi e alla progettazione con una forma mentis molto diversa rispetto a quella “computazionale” tipica del mondo informatico.

Nel 2006 Jeannette Wing, direttrice del Dipartimento di informatica della Carnegie Mellon University, formulò la seguente definizione di **Pensiero Computazionale:**

il pensiero computazionale è un processo di formulazione di problemi e di soluzioni in una forma che sia eseguibile da un agente che processi informazioni.

Il pensiero computazionale

Il Computational Thinking non consiste semplicemente nel saper programmare, ma nel <u>pensare a diversi livelli di astrazione</u>

Il pensiero computazionale è quindi un processo mentale che consente di risolvere problemi di varia natura seguendo metodi e strumenti specifici, pianificando una strategia; abitua al rigore e quindi rende possibili gli atti creativi.

Permette di interagire con persone e strumenti, di fruire delle potenzialità delle macchine quali oggetti capaci di compensare le lentezze o l'imprecisione dell'uomo, se ben programmati.

Pensiero computazionale vs Design

Come tutte le scienze, ha i suoi fondamenti formali nel linguaggio matematico e ha a che fare con oggetti del mondo reale. Il pensiero computazionale è infatti basato sulla <u>suddivisione di un problema in sotto-problemi così da poter giungere ad una formalizzazione del problema sotto forma di algoritmo (serie di passi).</u>

Nel mondo del design invece, la progettazione è tipicamente affrontata in maniera globale.

L'obiettivo principale del design di prodotto non è necessariamente quello di trovare una soluzione al problema specifico ma è piuttosto quello di **comprendere il problema nel suo insieme**

Pensiero Computazionale vs Design

Nel mondo del design il primo passo è sempre quello di capire **perchè il problema esiste** e solo dopo aver appurato che l'origine di un problema non può essere eliminata o mitigata ci si adopera per cercare di risolverlo nello specifico.

Viceversa, l'informatico medio non appena si trova davanti ad un problema, apre il proprio editor di testo e inizia a scrivere un algoritmo per cercare di risolverlo senza neanche chiedersi se il problema che si sta affrontando esiste veramente

Il problema esiste veramente?

George Berkeley, un filosofo irlandese del '700 sosteneva che *gli oggetti esistono solo in quanto percepiti*. Dunque, se un albero cade in una foresta e nessuno lo sente, non fa rumore.

Se un problema non è percepito da un utente allora quel problema non esiste.

Nel design dell'interazione l'obiettivo primo è quindi quello di avere un utente soddisfatto non un software teoricamente perfetto or super-ricco di funzionalità.

L’utente è il vostro nuovo capo

Questo può portare a situazioni che dal punto di vista informatico sono percepite come assurde.

Nel design di prodotto ci si trova infatti spesso costretti a modificare i requirement e le specifiche di prodotto per andare in contro alle esigenze degli utenti e sacrificando funzionalità tecniche e qualità dell'implementazione software.

Trovare il corretto bilanciamento fra esperienza utente, funzionalità e qualità tecnica è la parte più complessa dell'intero processo di sviluppo prodotto.

L’utente è il vostro nuovo capo

Questo processo antropocentrico di adattamento del software alle esigenze dell'utente piuttosto che al virtuosismo tecnico è spesso vissuto dalla maggior parte degli informatici come un'assurda violenza.

Per questo motivo è molto importante che gli informatici studino i principi del design, perché il mondo del design antropocentrico è per i tecnici tipicamente molto complicato da metabolizzare in quanto distante dal pensiero computazionale.

E' importante evidenziare che design dell'interazione e pensiero computazionale non sono mutualmente esclusivi, anzi!

E' nell'unione dei due e nell'integrazione dei due processi di studio e progettazione che nascono prodotti di successo e software di qualità.

“If we want users to like our software, we should design it to behave like a likeable person: respectful, generous and helpful.”

— Alan Cooper, software designer and programmer (Widely recognized as the “Father of Visual Basic")

Interaction Design

Il mondo della progettazione è diventato talmente ampio e variegato che il termine design da solo ormai non ha quasi più significato. Esistono varie sotto discipline del design e con queste numerose professioni, metodi di lavoro, scuole di pensiero e altrettante immancabili faide e lotte fra fazioni.

Un informatico può fare a meno di conoscere al completo il mondo del design ma non può esimersi da possedere i rudimenti base del “design dell'interazione”.

Interaction design, o progettazione dell'interazione, è l'attività di progettazione dell'interazione che avviene tra esseri umani e oggetti in generale.

Interaction Design

L'obiettivo principale dell'interaction design è quello di rendere macchine, servizi e sistemi usabili dagli utenti per cui sono stati pensati e realizzati e non solamente dai propri creatori.

All'interno di un processo di interaction design, si investigano l'uso che verrà fatto dell'artefatto e il target a cui esso si rivolge. Questo significa che le questioni legate agli utenti guidano il processo più di quanto non facciano le questioni tecniche.

Gli sviluppatori devono mettere al centro del processo di sviluppo i bisogni degli utenti, arrivando a realizzare un prodotto più appropriato e maggiormente usabile.

Le forze trainanti lo sviluppo di un prodotto dovrebbero essere quindi gli utenti reali e i loro bisogni e non solo le tecnologie.

Human Machine e Human Computer Interaction

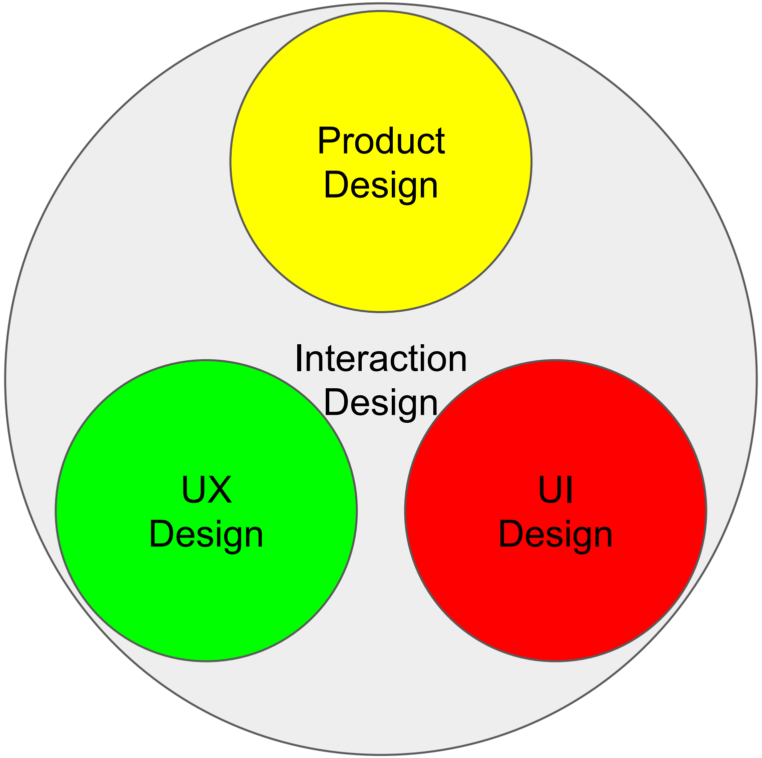
Nel nostro caso ci focalizzeremo sull'interazione tra uomo e sistemi informatici e quindi andremo a lavorare nel campo dell'interazione uomo-macchina e uomo-computer (in Inglese HMI Human-Machine Interaction e HCI Human Computer Interaction).

L'obiettivo principale del HMI e HCI design è quindi rendere possibile e facilitare al massimo, per un essere umano, l'uso e l'interazione con sistemi del mondo IT (Information Technology) quali, calcolatori, dispositivi mobili, servizi web etc.

Interaction Design

Sotto discipline:

- design di prodotto
- design dell'esperienza utente (UX design)
- design dell'interfaccia (UI Design)



Design di Prodotto

E’ un processo strategico di risoluzione dei problemi che guida l'innovazione e porta a una migliore qualità della vita attraverso prodotti, sistemi, servizi ed esperienze innovative **(Definizione ufficiale di disegno industriale, coniata nel 2015 dalla World Design Organization).**

NB: Spesso design di prodotto e design industriale sono utilizzati in modo intercambiabile

<u>Nel design di prodotto si progettano quindi beni e servizi il cui obiettivo principale è quello di essere utilizzati da quanti più utenti possibili migliorandone la vita.</u>

Il designer di prodotto è quindi colui che inventa un nuovo modo o un nuovo oggetto per fare cose che fino a ieri non si potevano fare o si facevano in maniera più complicata.

L’inventore

L'inventore (designer) del prodotto si focalizza su un problema da risolvere e inventa un prodotto che grazie alle sue caratteristiche tecniche permette di risolvere il problema.

http://cherryhappygirl.blogspot.com/2017/05/product-designer-vs-ux-designerwhich.html

Progettiamo Spotify

- **Nome prodotto:** Spotify
- **Problema a cui assolve:** Ascoltare musica senza possederla;
- **Tipologia di prodotto:** Servizio basato su Internet;
- **Funzionalità Principale:** Consentire l'ascolto di qualunque brano, su qualsiasi piattaforma senza richiedere l'acquisto di un supporto fisico e dei diritti d'autore;
- **Soluzioni esistenti simili (competitor):** Noleggio/prestito CD e altri supporti fisici, download di musica pirata;
- **Soluzione:** Servizio di streaming basato su business model "freemium" che di fatto rappresenta un jukebox con brani pressoché illimitati;
- **Requisiti per l'utilizzo:** PC o smartphone o tablet, Connessione internet.

Spotify Canvas

Key Partnerships

Partnerships in the music industry are essential to making the business model work. Spotify has many important corporate partners

Record Labels
Partnered with Record Labels, received investment.Help to manage DRM and copyright laws

Facebook
Facebook integration in 2011 helped Spotify grow exponentially in global market

Ongoing partnerships with content producers and labels

Key Resources

Huge MAU, Brand, Partners

- Large MAU base gives them leverage over industry
- Brand synonymous with streaming, trusted in the space
- Partners help drive path to profitability

Key Activities

New Products, Maintain Sub Base

- Continue launching new content, like Podcasts, to keep engagement high
- Ensure that churn on Premium Sub base continues to be maintained

Value Proposition

Subscription-based streaming music service. Stream curated playlists and new music anywhere, on any device:

- No need to download files and clog up device memory when listening to music
- New songs and podcasts constantly coming out, no need to 'buy' music

Customer Relationships

Cater to Premium Subs

- Offer continuous incentives to keep Premium Subs in the service
- Continuous product improvements keep customers engaged

Channels

Digital and Events

- Main customer channel is through the mobile app; majority of customer base is Millennials
- Offering more and more physical events

Customer Segments

Millennials, European Market

- Streaming represents 75% of music industy's revenues
- Millennials are responsible for the majority of the 'streaming revolution'
- 35% of Spotify's MAUs come from Europe, as the service started in Sweden in 2006
- US market increasingly competitive, represents 27% of MAUs

Cost Structure

Licensing- Spotify has paid more than $10 billion in royalties to artists and labels

Platform- Platform R&D is a large cost item

Marketing - Sales & Marketing costs remain high, as competition for new users continues to increase

Revenue Streams

Premium Memberships: average cost per month is $10 per month in North America. ARPU is €4.76 globally as of Q3 '19. Premium Subs drive 90% of revenue

Ad-Supported: freemium users can use Spotify, but they will see Ads. Represents 10% of Spotify's revenues.

E quindi?.....

E' chiaro però che questo nuovo prodotto potrebbe essere realizzato in tanti modi e che sarà proprio il modo in cui viene costruito a decretarne il successo o il fallimento del prodotto.

Questo perché non basta un'idea per fare un prodotto di successo, ci vuole un lungo e complicato processo di progettazione che vada oltre l'idea e metta al centro l'utente, i suo bisogni e le sue aspettative.

User Experience Designer (UX Designer)

UX Designing is completely related to how the product feels and completely different from traditional graphic design.

UX design focuses on the logic and structure behind the elements you actually interact with on any web or mobile application or any software.

The UX designers through different approaches to solving the user-specific problem and completely user-centric.

The UX designers use a variety of tools and methods to understand information architecture, human factors and end users by competitive analysis and user interviews by building user persona, wireframe the product for UI design and the flow of the application.

User Experience Designer (UX Design)

Il **design dell'esperienza utente** è il processo volto ad aumentare la soddisfazione e la fedeltà del cliente migliorando l'usabilità, la facilità d'uso e il piacere fornito nell'interazione tra il cliente e il prodotto.

La progettazione dell'esperienza utente comprende la tradizionale progettazione dell'interazione uomo-macchina e la estende integrandola con tutti gli aspetti di business, marketing e sviluppo prodotto necessari per garantire il successo del prodotto e/o servizio.

UX Designer

Lo UX Designer ha quindi l'obiettivo di far vivere all'utente del suo prodotto la miglior esperienza possibile, evitando quindi che l'oggetto induca nell'utente sensazioni di frustrazione e delusione.

Spesso si tende a dire che si “progetta l'esperienza utente”. In realtà è impossibile progettare l'esperienza utente perchè ogni utente è diverso dall'altro ed è quindi illusorio pensare che chiunque durante l'utilizzo del prodotto si comporti alla stessa maniera e in particolare si comporti esattamente come il progettista ha ipotizzato.

User Experience

“*every product that is used by someone has a user experience: newspapers, ketchup bottles, reclining armchairs, cardigan sweaters.”* (Garrett, 2003)

<u>You can’t design a user experience, only design for a user experience</u>

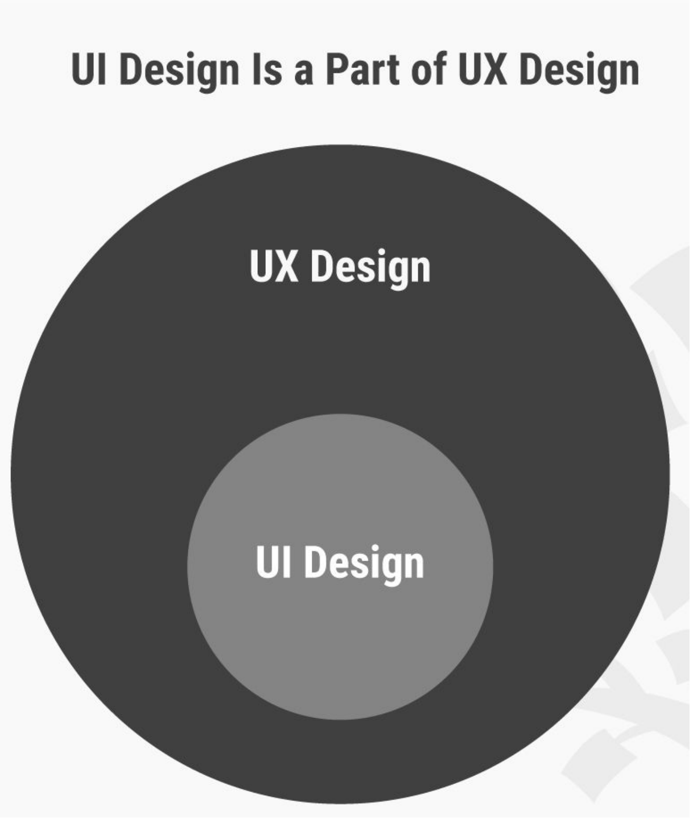
UX Design

Come vedremo nei capitoli successivi, lo studio e la progettazione dell'esperienza utente partono sempre dalla analisi e comprensione delle esigenze dell'utente e non dalle specifiche funzionali di prodotto.

User Interface designer (UI design)

Il Design dell'interazione ha come focus il modo in cui le persone interagiscono con la tecnologia, lo scopo è migliorare la loro comprensione di ciò che si può fare, ciò che succede e ciò che è appena successo, basandosi su principi psicologici, tecnici ed estetici.

Dallo studio della UX si crea quindi uno schema di interazione che poi viene passato allo UI Designer che ha il compito di progettare l'interfaccia utente al fine di abilitare l'esperienza progettata.



User Interface designer (UI designer)

Lo UI designer non costruisce quindi l'interfaccia utente, nei team numerosi questa figura è spesso un progettista grafico e non un informatico.

L'obiettivo dello UI designer è quello di progettare l'aspetto estetico e la struttura dell'interfaccia così che questa durante l'utilizzo induca l'utente nel seguire l'esperienza che è stata per lui progettata.

Lo UI designer produce quindi un wireframe, una bozza grafica, dell'interfaccia e una serie di linee guida che poi verranno seguite dagli sviluppatori (UI developer o Front-end developer) per implementare la reale interfaccia del prodotto o servizio

User Interface designer (UI designer)

UI Designer is in charge of giving the art of feeling the project to end-client.

He/she need to think in shapes, surfaces, shading, consistency, visual appearance of the project in view of the UX provided.

He/she need to have the capacity to clear the questions of Front-end (UI) developer on the off chance that he/she incorporates any new components available in the market and ought to have the capacity to furnish the developer with its asset or documentation.

His/her duty is likewise to make design guidelines in view of which encourage developers or visual planners will work.

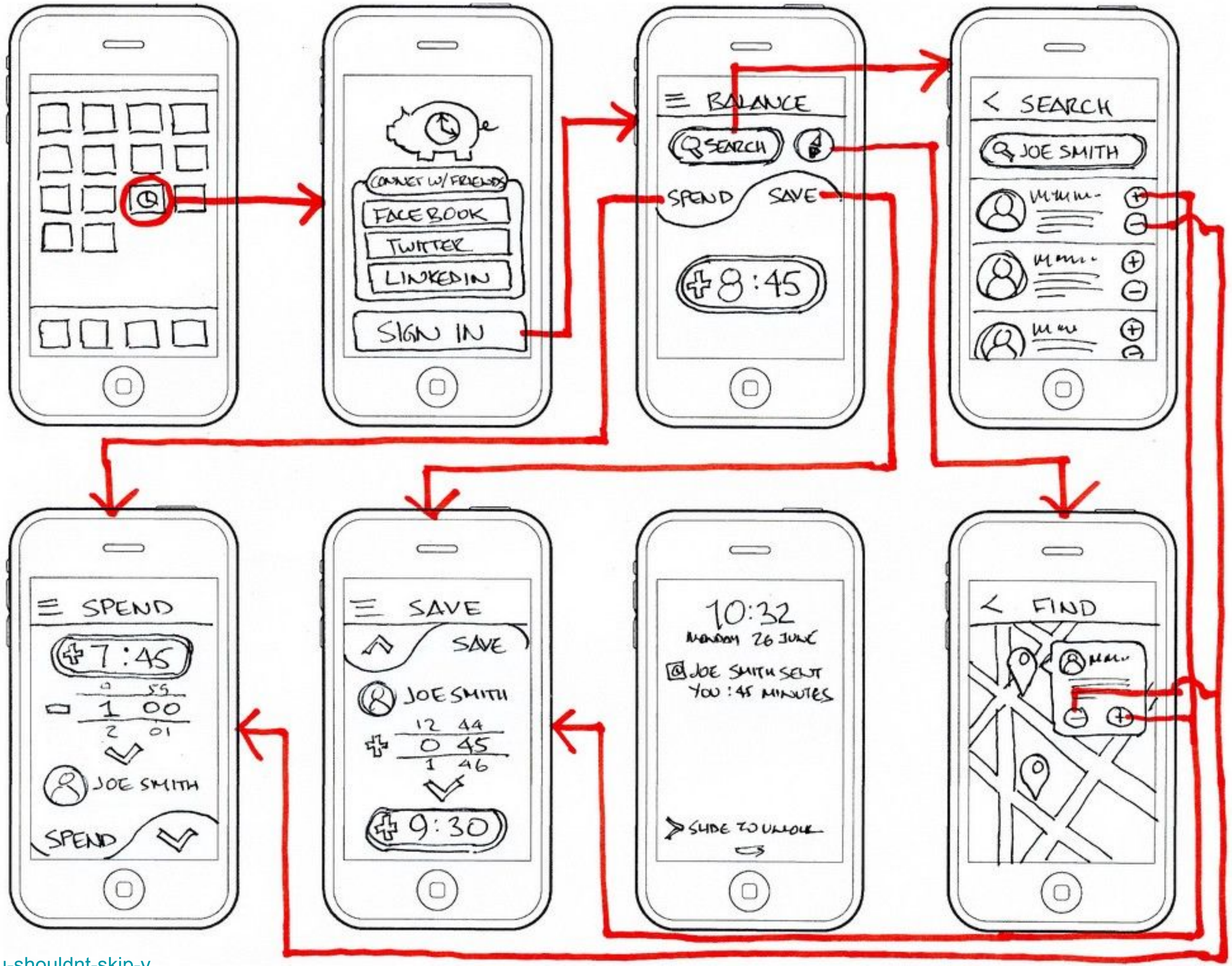


immagine tratta da
https://blog.prototypr.io/why-you-shouldnt-skip-your-wireframing-1f7a70d5c125

User Interface design vs User Experience design

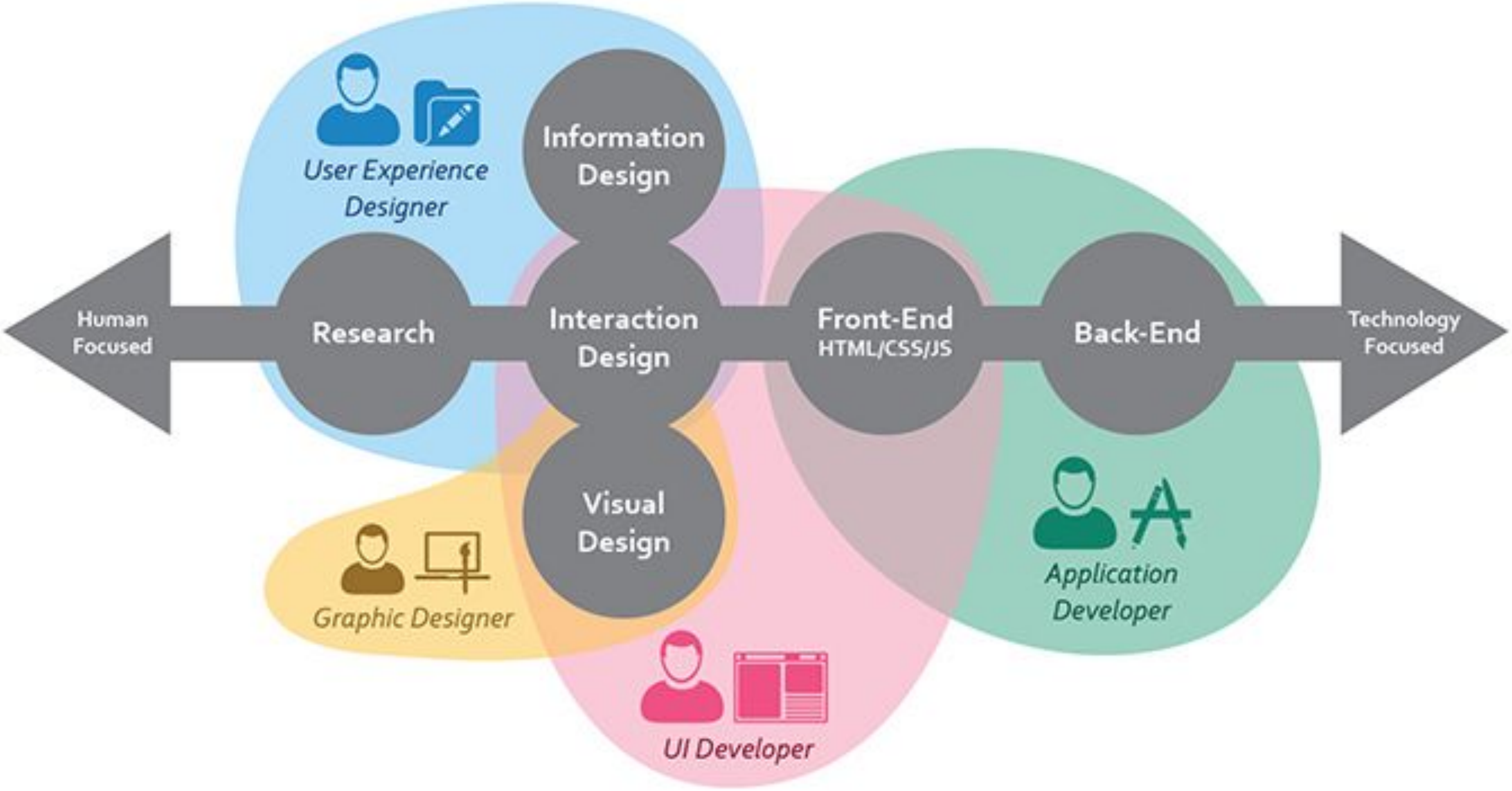
source: https://nzdigital.co.nz/ui-and-ux/

Front-end Developer (UI Developer)

They ought to have the creation expertise to have the capacity to transform the UI and UX configuration given into the HTML, CSS, JavaScript,... [other languages] that arrangements with the marvels of program compatibilities.

This requires profound information of how modern rendering framework works and ought to have the capacity to execute the UI Design into the functional product.

The real assignment of Front-end engineer is to furnish the last outcome with all connection streams portrayed in the UI Design by UI Designer.



https://www.crayondata.com/blog/the-difference-between-ui-and-ux/

Human Centered Design

Human Centered Design

I progettisti devono produrre cose che soddisfino i bisogni della gente, in termini di funzioni, facilità d'uso e gratificazione emotiva. In altre parole, il design (di prodotto) deve essere pensato come un'esperienza totale (per l'utente).

[Donald Norman — La caffettiera del masochista]

Human Centered Design

Le persone sono sempre più frustrate dalla complessità degli oggetti quotidiani. Dalla complessità sempre maggiore del cruscotto dell'auto, dalla lavatrice piena di incomprensibili funzioni e pulsanti, dalla crescente automazione della casa, e dalla continua proliferazione di funzioni che i progettisti aggiungono con orgoglio ad ogni nuova versione dei loro prodotti.

La vita della maggior parte degli utenti è ormai diventata una battaglia quotidiana per la sopravvivenza alla invadente e iper-funzionale tecnologia.

Human Centered Design

Questo problema origina direttamente dalla modalità con la quale vengono oggigiorno progettati gli oggetti quotidiani ed in particolare quelli tecnologici.

Le macchine (computer) hanno una modalità di funzionamento logica, dovuta all'algoritmo che il progettista ha sviluppato come anima della macchina. Noi umani invece siamo tutt'altro che logici e razionali, siamo intuitivi, flessibili, versatili e curiosi.

<u>E' chiaro quindi che nell'interazione uomo-macchina si va a creare una relazione fra specie diverse che hanno modalità di pensiero e di funzionamento opposte.</u>

Human Centered Design

Gli ingegneri e gli informatici, orgogliosi dei loro progressi tecnologici, hanno preteso da sempre che gli umani si adattassero alle loro macchine.

Le macchine sono viste dai progettisti come un elemento di orgoglio che rappresenta il progresso e chi non è in grado di capirle è retrogrado, vecchio e a volte anche un po' stupido.

Questo approccio tecno-centrico dei progettisti ha in realtà leso lo sviluppo stesso della tecnologia dal momento che ne ha rallentato la sua diffusione e accettazione.

La maggior parte degli utenti oggi è frustrata dall'utilizzo di incomprensibili oggetti tecnologici di cui non capisce il principio di funzionamento e dove tipicamente si limita ad utilizzare il 10% delle funzionalità disponibili.

Human Centered Design

Le macchine hanno delle loro regole di funzionamento che sono spesso note solo ai progettisti. Quando non si seguono queste regole le cose non vanno come previsto e l'utente si sente stupido ed incapace. La macchina è perfetta, non può sbagliare, quindi se le cose sono andate male è sicuramente colpa dell'umano.

E' vero! ma non è l'umano utente ad aver sbagliato, la colpa è del progettista!

Nel design antropocentrico si inverte il paradigma di progettazione mettendo l'utente al centro del processo.

Le funzionalità del prodotto vengono dopo. Prima ci sono i bisogni dell'utente!

Human Centered Design

Human-centred design **is an approach to interactive systems development** that **aims to make systems usable and useful by focusing on the users**, their needs and requirements, and by applying human factors/ergonomics, usability knowledge, and techniques.

This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance.

ISO 9241-210:2010(E)

Human Centered Design

Questo processo, apparentemente ovvio e banale, risulta in realtà estremamente difficile da applicare per gli informatici.

I tecnici infatti amano le funzioni e le funzionalità, amano le peculiarità tecniche dei sistemi e sono spesso spinti a sviluppare nuove soluzioni non tanto per risolvere il problema ma piuttosto per la soddisfazione personale di aver implementato qualcosa che prima non esisteva.

Esempio di sviluppo tecno-centrico

La blockchain, creata per diletto da degli appassionati di crittografia, ha dato vita alla prima criptomoneta della storia.

Dopo il boom di Bitcoin e delle altre cryptomonete è scoppiata la bolla blockchain dove tutti nel mondo IT hanno iniziato a dichiarare che grazie alla blockchain si sarebbe potuto innovare in maniera radicale tantissimi settori.

Ad oggi in realtà non si è ancora trovata per la blockchain un'applicazione di successo alternativa alle cryptomonete e che non fosse in precedenza comunque realizzabile.

Esempio di sviluppo tecno-centrico

Per dirla in altre parole, nessun utente ci ha chiesto di sviluppare la blockchain in quanto tale, c'era bisogno di scambiarsi denaro in maniera alternativa e quindi sono nate le cryptomonete e la blockchain è nata come tecnologia per abilitarle.

Ora la corsa a cercare di applicare la blockchain ad altri settori non sta funzionando perché stiamo cercando un problema per una tecnologia e non una tecnologia per risolvere un problema!

Sviluppo Antropocentrico

La morale di questo ragionamento è molto semplice: se vogliamo progettare tecnologia per le persone dobbiamo capire sia la tecnologia che le persone.

Dobbiamo smettere di progettare per le persone come vorremmo che fossero e iniziare a progettare per come realmente sono!

Human Centered Design

Human-centered design is a design philosophy.

It means starting with a good understanding of people and the needs that the design is intended to meet.

This understanding comes about primarily through **observation, for people themselves are often unaware of their true needs,** even unaware of the difficulties they are encountering.

Human Centered Design

human-centered design (HCD), **an approach that puts human needs, capabilities, and behavior first, then designs to accommodate those needs,** capabilities, and ways of behaving.

Good design requires good communication, especially from machine to person, indicating what actions are possible, what is happening, and what is about to happen.

Communication is especially important when things go wrong. It is relatively easy to design things that work smoothly and harmoniously as long as things go right. But as soon as there is a problem or a misunderstanding, the problems arise.

Human Centered Design

Designers need to **focus their attention on the cases where things go wrong**, not just on when things work as planned.

Actually, this is where the most satisfaction can arise: when something goes wrong but the machine highlights the problems, then the person understands the issue, takes the proper actions, and the problem is solved.

When this happens smoothly, the collaboration of person and device feels wonderful.

Viva i Bug! Viva i crash!

Non bisogna aver paura che l'utente abbia problemi o che il nostro software abbia degli errori o bug, è inevitabile che questo accada.

E' importante quindi progettare perché <u>l'utente venga guidato nella risoluzione e gestione dell'errore senza provare frustrazione</u>. Avremo così un utente soddisfatto.

Le emozioni degli utenti

L'esperienza di utilizzo produce emozioni negli utenti, più emozioni positive (successi) l'utente avrà e migliore sarà la percezione che avrà del nostro prodotto.

E' importante sottolineare inoltre che <u>i ricordi hanno la capacità di far provare emozioni più profonde rispetto al presente.</u>

Un utente che di fronte ad un problema riesce a risolverlo perché ben guidato dalla tecnologia avrà memoria di un suo successo. Questo tipo di sensazioni sono molto forti e se associate al prodotto fanno si che l'utente sviluppi empatia per il prodotto e che quindi lo apprezzi e ne senta il bisogno.

L'obiettivo dello HCD deve essere quindi quello di **creare nell'utente empatia verso il sistema**.

Human Centered Design

Getting the specification of the thing to be defined is one of the most difficult parts of the design, so much so that the **HCD principle is to avoid specifying the problem as long as possible but instead to iterate upon repeated approximations.**

This is done through rapid tests of ideas, and after each test modifying the approach and the problem definition.

Human Centered Design

L'HCD è quindi una forma di pensiero ed è quindi compatibile con le varie discipline del design di prodotto che abbiamo precedentemente introdotto

Si può infatti applicare il pensiero HCD sia al design industriale che alla progettazione dell'interazione o dell'esperienza utente, lo **HCD non è un'area o un metodo, è una forma di pensiero.**

TABLE 1.1. The Role of HCD and Design Specializations	
Experience design	These are areas of focus
Industrial design	
Interaction design	
Human-centered design	The process that ensures that the designs match the needs and capabilities of the people for whom they are intended

Human Centered Design

Human-centered design is a creative approach to problem solving […]. It’s a process that starts with the people you’re designing for and ends with new solutions that are tailor made to suit their needs. Human-centered design is all about building a deep empathy with the people you’re designing for.

— fonte: www.designkit.org/human-centered-design

D. Norman HCD principles https://www.youtube.com/watch?v=rmM0kRf8Dbk&ab_channel=NNgroup

Human Centered Design

A sottolineare quanto l'HCD sia ritenuto oggigiorno fondamentale per la progettazione di sistemi destinati all'utilizzo umano, è importante ricordare che il design antropocentrico è ormai parte della norma ISO EU.

ISO 9241-210:2019 Ergonomics of human-system interaction Part 210: Human-centred design for interactive systems

This document provides requirements and recommendations for human-centred design principles and activities throughout the life cycle of computer-based interactive systems. It is intended to be used by those managing design processes, and is concerned with ways in which both hardware and software components of interactive systems can enhance human-system interaction.

Human Centered Design

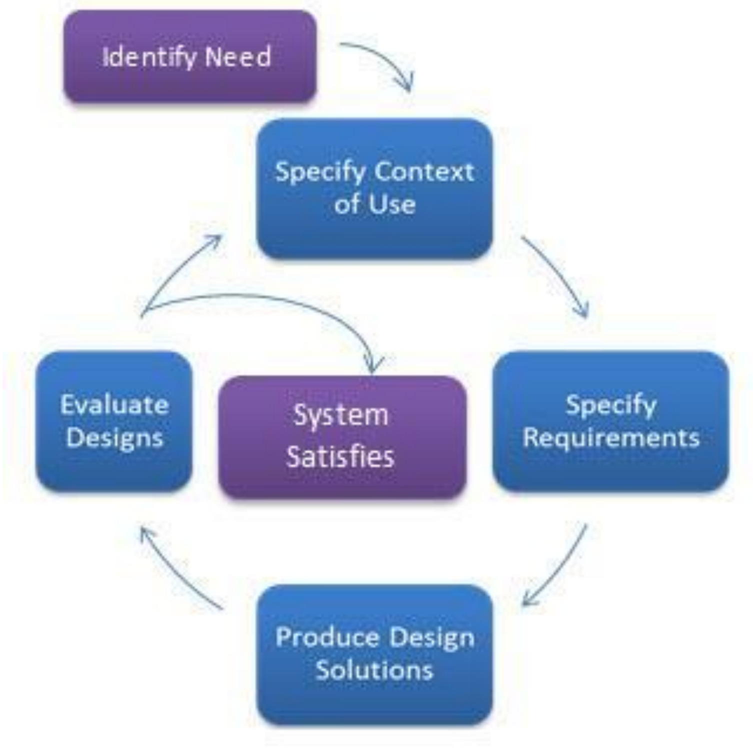
Un buon processo HCD parte sempre dall'osservazione dell'utente e dei suoi bisogni.

Tuttavia, tale osservazione non è sempre possibile o facile da attuare.

Analizzeremo varie tecniche di prototipazione rapida e metodi di lavoro finalizzati all'estrazione veloce di bisogni utente e all'esecuzione rapida e a basso costo di test.

Possiamo schematizzare un processo di HCD come un flusso continuo ed iterativo che attraversa le seguenti fasi:

- **Specificare il contesto d'uso:** identificare gli utenti che utilizzeranno il prodotto, per cosa lo utilizzeranno e sotto quale condizioni e vincoli;
- **Specificare i Requirements:** Identificare i business requirement e gli obiettivi utente che devono essere raggiunti grazie all'utilizzo del software;
- **Progettare la soluzione:** questa fase può essere a sua volta spacchettata in sotto fasi iterative. Si passa tipicamente da delle bozze a dei prototipi e poi alla soluzione;
- **Testare e valutare:** è fondamentale testare e quindi valutare il sistema così da poter iniziare il ciclo sulla base dei risultati dei test e quindi procedere ad uno sviluppo e miglioramento incrementale.



https://www.usability.gov/what-and-why/user-centered-design.html

Human Centered Design

Per ora, al fine di inquadrare meglio la filosofia HCD nel contesto dello sviluppo software vi basti pensare che le versioni alfa e beta dei nostri software possono diventare potenti strumenti di analisi degli utenti. Le versioni di test non servono quindi solamente a fare debugging del codice e delle funzioni, ma servono anche e soprattutto a capire che cosa fanno e come si comportano gli utenti durante l'utilizzo del nostro software.

Nello sviluppo software diventa quindi indispensabile abilitare dei sistemi di tracking dell'utente finalizzati alla produzione di statistiche di utilizzo.

Progettare l’interazione

Progettare l’interazione

Esistono solo due tipi di design, riuscito e fallito; buono e cattivo (D. Norman).

Il problema è che il buon design non è universale. Un progetto, prodotto o sistema apprezzato da tutti non esiste perché l'esperienza di interazione è soggettiva e quindi dipende più dalla persona che non dell'artefatto e di conseguenza è statisticamente impossibile progettare qualcosa che sia apprezzato da chiunque.

Two of the most important characteristics of good design are **discoverability** and **understanding**.

Discoverability

è la capacità di un sistema di veicolare e comunicare i propri possibili usi all'utente.

Un sistema che a prima vista fa capire all'utente a cosa serve e che cosa ci si può fare ha una buona Discoverability

Per avere una buona discoverability si usa tipicamente la **visibilità**

Non è detto però che una volta capito cosa si può fare si riesca a farlo.

Discoverability

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Discoverability

Understanding

è invece la capacità del prodotto di farsi usare correttamente dall'utente.

Se la discoverability è la misura di quanto bene si capisce **cosa** si può fare con il prodotto, la understanding invece è la proprietà associata a quanto bene un prodotto dice **come** si usano le funzioni disponibili.

Per capire come si usa un prodotto non basta infatti aver identificato quali sono i controlli, è necessario dare con facilità risposta alle seguenti domande:

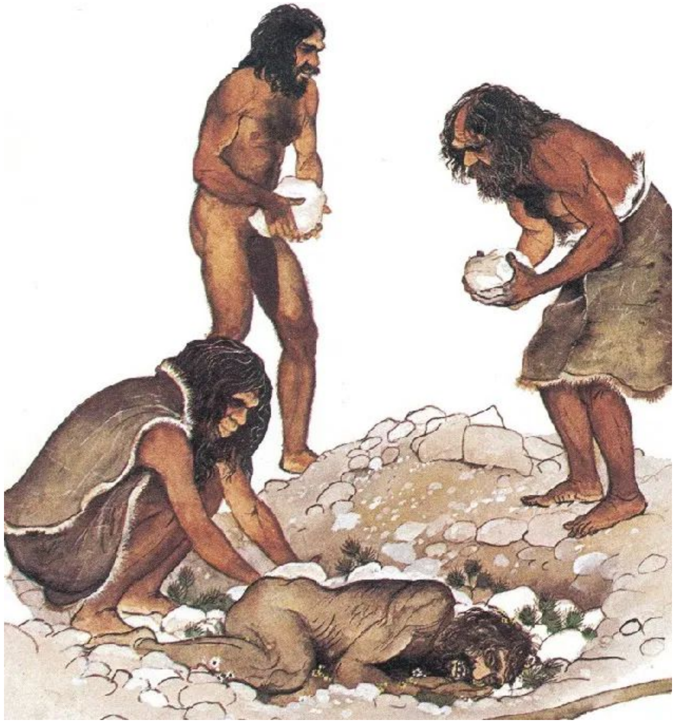
- Come si usa il prodotto?
- Che funzione ha ciascun controllo?
- Come si combinano i controlli?

Understanding

UNDERSTANDING

Design of useful things

Quando le cose vanno bene, si dimenticano subito, quando vanno male non si dimenticano mai!



Design of useful things

Design is concerned with how things work, how they are controlled, and the nature of the interaction between people and technology.

When done well, the results are brilliant, pleasurable products. When done badly, the products are unusable, leading to great frustration and irritation.

Design of useful things

Machines, are conceived, designed, and constructed by people.

By human standards, **machines are pretty limited**. Instead, machines usually follow rather simple, rigid rules of behavior. If we get the rules wrong even slightly, **the machine does what it is told, no matter how insensible and illogical.**

People are imaginative and creative, filled with **common sense**; that is, a lot of valuable knowledge built up over years of experience. But instead of capitalizing on these strengths, **machines require us to be precise and accurate, things we are not very good at.**

Machines have no leeway or common sense. Moreover, <u>many of the rules followed by a machine are known only by the machine and its designers.</u>

Design of useful things

It is time to reverse the situation: to cast the blame upon the machines and their design. **It is the machine and its design that are at fault.**

It is the duty of machines and those who design them to understand people. It is not our duty to understand the arbitrary, meaningless dictates of machines.

The reasons for the deficiencies in human-machine interaction are numerous. But **most of the problems come from a complete lack of understanding of the design principles** necessary for effective human-machine interaction.

Why this deficiency? **Because much of the design is done by developers who are experts in technology but limited in their understanding of people.**

Design of useful things

“We are people ourselves,” they think, “so we understand people.”

But in fact, we humans are amazingly complex.

Developers typically **make the mistake of thinking that logical explanation is sufficient:** “If only people would read the instructions, everything would be all right.”

Engineers are trained to think logically. As a result, **they come to believe that all people must think this way, and they design their machines accordingly.**

Design of useful things

The problem with the designs of most engineers is that they are too logical.

We have to accept human behavior the way it is, not the way we would wish it to be.

Design of useful things

Donald Norman: *“we were designing things for people, so we needed to understand both technology and people. But that’s a difficult step for many engineers: machines are so logical, so orderly. If we didn’t have people, everything would work so much better. Yup, that’s how I used to think.”*

Three Mile Island accident

Critical user interface engineering problems were revealed in the investigation of the reactor control system's user interface. Despite the valve being stuck open, a light on the control panel ostensibly indicated that the valve was *closed*. In fact **the light did not indicate the position of the valve, only the status of the solenoid being powered or not**, thus giving false evidence of a closed valve. **As a result, the operators did not correctly diagnose the problem for several hours**

https://it.wikipedia.org/wiki/Incidente_di_Three_Mile_Island

Fundamental principles of interaction

Life is made of experiences

Great designers produce pleasurable **experiences**. Engineers tend not to like it; it is too subjective. But…

“when I ask them about their favorite automobile or test equipment, they will smile delightedly as they discuss the fit and finish, the sensation of power during acceleration, their ease of control while shifting or steering, or the wonderful feel of the knobs and switches on the instrument.” **Those are experiences! (D. Norman)**

Experience is critical, for it determines **how fondly people remember their interactions**. Was the overall experience positive, or was it frustrating and confusing?

Donald Norman video course playlist

https://www.youtube.com/playlist?list=PLAwxTw4SYaPlr4Uq3RoYuwlDADp0WQdGl

Cognition and emotion

When our home technology behaves in an uninterpretable fashion we can become confused, frustrated, and even angry—**all strong negative emotions.**

When there is understanding it can lead to a feeling of control, of mastery, and of satisfaction or even pride — **all strong positive emotions.**

Cognition and emotion are tightly intertwined, which means that the designers must design with both in mind.

https://www.youtube.com/watch?v=LTE-v4RzRHs&list=PLJOFJ3Ok_idv_6hQGNt23xVXuQwKFmfxG&index=8&ab_channel=NNgroup

Discoverability

When we interact with a product, **we need to figure out how to work it.** This means **discovering** what it does, how it works, and what operations are possible.

Discoverability results from appropriate application of 6 **fundamental psychological principles:**

- **affordances**
- **signifiers**
- **constraints**
- **mappings**
- **feedback**
- **conceptual model of the system**

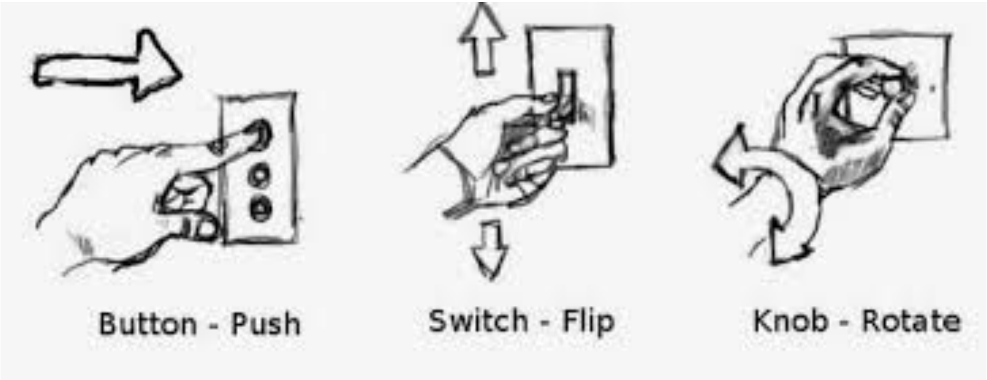
AFFORDANCES

Affordances

The term **affordance** refers to **the relationship** between a physical object and a person.

An affordance is a relationship between the properties of an object and the capabilities of the agent that determine just how the object could possibly be used.

A chair affords (“is for”) support and, therefore, affords sitting.



Affordances are relationships

We are used to thinking that properties are associated with objects.

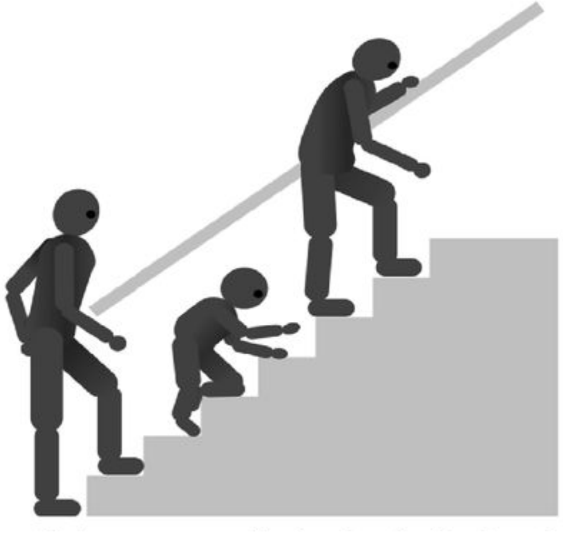
But **affordance is not a property.**

An **affordance is a relationship.**

Whether an affordance exists depends upon the properties of both the object and the agent.

Affordances are relationships

Most chairs can also be carried by a single person (they afford lifting), but some can only be lifted by a strong person.
If young or relatively weak people cannot lift a chair, then for these people, the chair does not have that affordance, it does not afford lifting.



https://www.youtube.com/watch?v=NK1Zb_5VxuM&ab_channel=Interaction-Design.org

Anti-affordance

anti-affordance -> the prevention of interaction.

Affordances

To be effective, affordances and anti-affordances have to be: **discoverable and perceivable**.

This poses a difficulty with glass. The reason we like glass is its relative invisibility, but this aspect, so useful in the normal window, also hides its anti-affordance property of blocking passage.

As a result, birds often try to fly through windows.

SIGNIFIERS

Signifiers

Designers have practical problems.

They need to know how to design things to make them understandable.

They soon discovered that when working with the graphical designs for electronic displays, they needed a way to designate which parts could be touched, slided upward, downward, or sideways, or tapped upon.

Signifiers

How could designers describe what they were doing?

There was no word that fit, so they took the closest existing word: **affordance**.

“I put an affordance there” to describe why they displayed a circle on a screen to indicate where the person should touch, whether by mouse or by finger.

NO -> that is not an affordance! That is a way of communicating where the touch should be.

You are communicating **where** to do the touching!

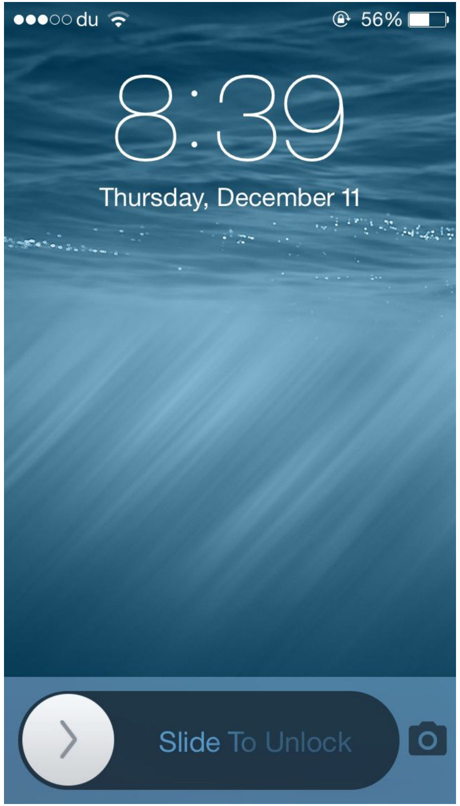
Signifiers

<u>**The affordance of touching exists on the entire screen**</u>:

That's not the same thing as saying **what** action is possible.

Affordances determine **what** actions are possible.

<u>**Signifiers** communicate **where** the action should take place.</u>



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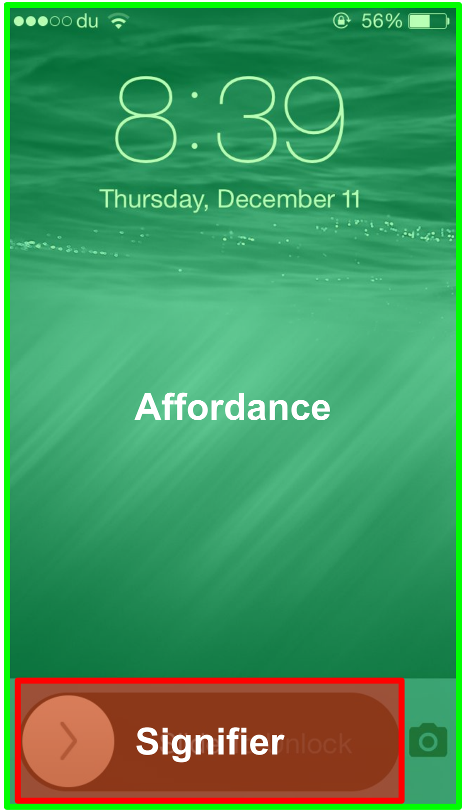


Signifiers

Signifiers can be **deliberate** and **intentional**, such as the sign push on a door

they may also be **accidental** and **unintentional**, such as our use of the visible trail made by previous people walking through a field or over a snow-covered terrain to determine the best path.

Figure 2. Crowds as social signifier. Did the train already leave? The state of the train platform provides the answer. Here, the presence or absence of waiting passengers serves as a social signifier, signifying a train that has

Signifiers

Affordances represent the possibilities in the world for how an agent can interact with something. Some affordances are perceivable, others are invisible.

Signifiers are signals. Some signifiers are signs, labels, and drawings placed in the world

Some signifiers are simply the perceived affordances, such as the handle of a door

<u>Note that some perceived affordances may not be real</u>

Signifiers

In design, signifiers are more important than affordances, for they communicate how to use the design

Perceiving affordances and signifiers

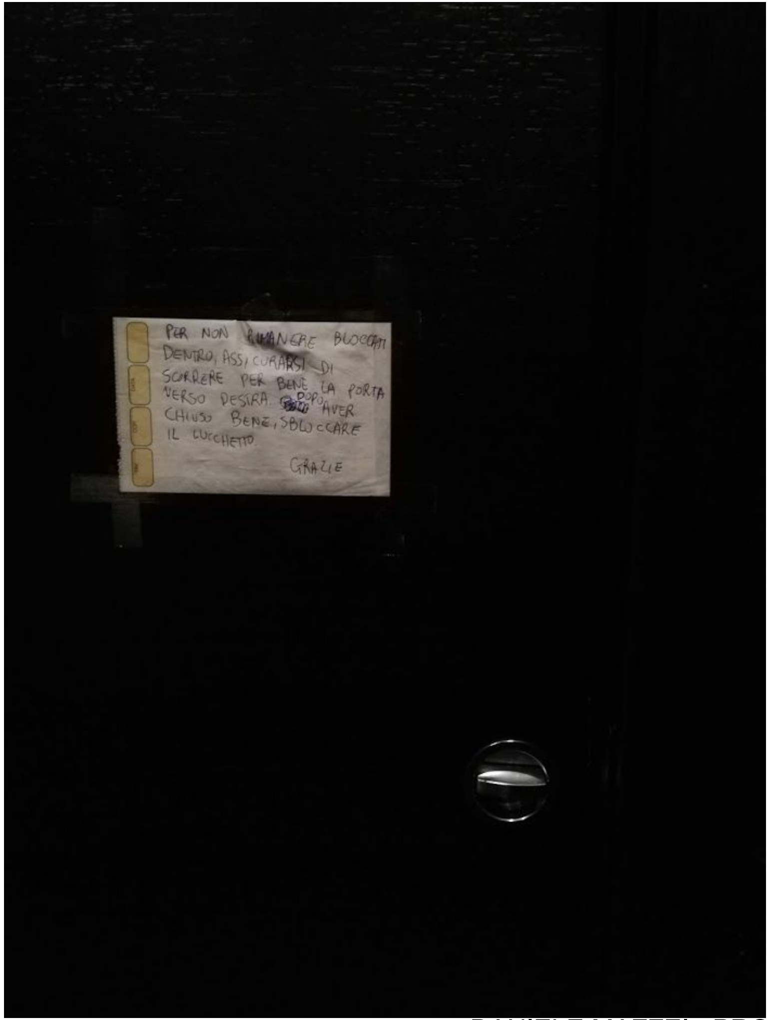
But how does one go from the perception of an affordance to understanding the potential action?

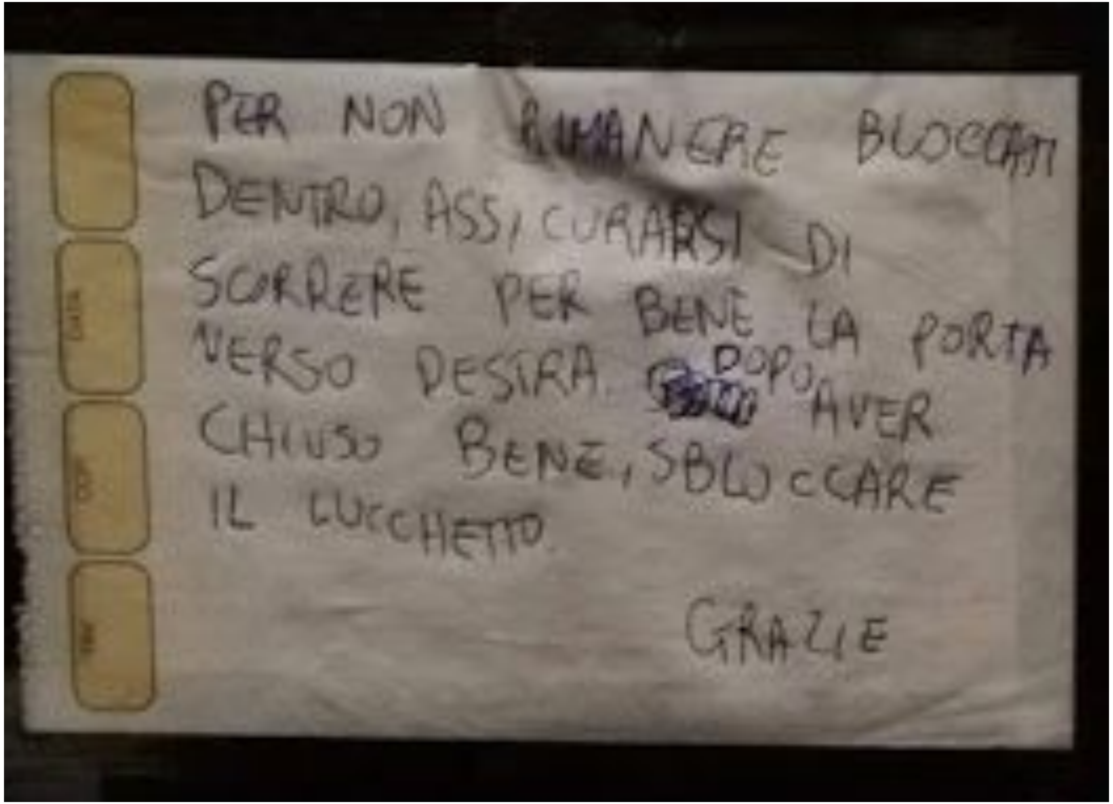
<u>In many cases, through conventions</u>.

A doorknob has the perceived affordance of graspability. But knowing that it is the doorknob that is used to open and close doors is learned: it is a cultural aspect of the design that knobs, handles, and bars, when placed on doors, are intended to enable the opening and shutting of those doors. The same devices on fixed walls would have a different interpretation: they might offer support, for example, but certainly not the possibility of opening the wall.

<u>The interpretation of a perceived affordance is a cultural convention.</u>

https://www.youtube.com/watch?v=UtuITXJLGOI&ab_channel=LeahGreis




PER NON RIMANERE BLOCCATI
DENTRO, ASSICURARSI DI
SCORRERE PER BENE LA PORTA
VERSO DESTRA. DOPO AVER
CHIUSO BENE, SBLOCCARE
IL LUCCHETTO.
GRAZIE

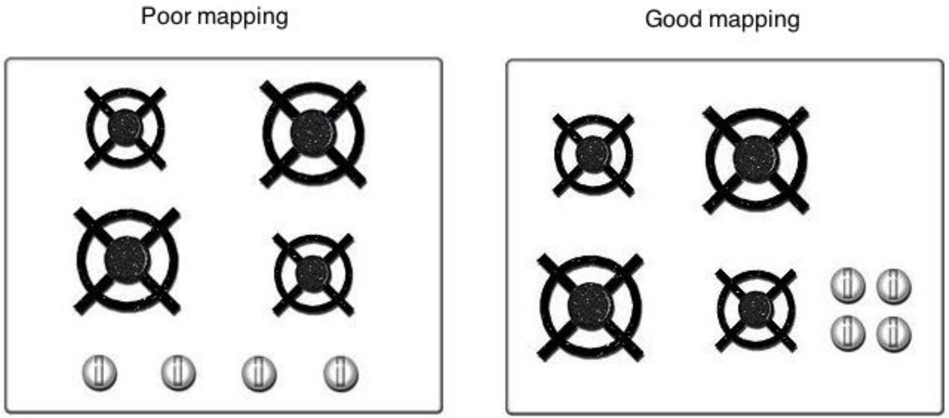
MAPPING

Mapping

<u>Mapping means the relationship between the elements of two sets of things.</u>

Mapping is an important concept in the design and layout of controls and displays. When the mapping uses spatial correspondence between the layout of the controls and the devices being controlled, it is easy to determine how to use them.

Natural mapping (taking advantage of spatial analogies) leads to immediate understanding.



Mapping

Some natural mappings are cultural or biological, as in the universal standard that moving the hand up signifies more, moving it down signifies less, which is why it is appropriate to use vertical position to represent intensity or amount.

Note that there are many mappings that feel “natural” but in fact are specific to a particular culture.


F
FITNESS
7
701 - 736
8
814 - 836
4
401 - 436
5
501 - 536
6
601 - 636
1
101 - 119
Conference
2
201 - 236
3
301 - 336
-2
Garage
-1
Garage
0
Bar
Lobby
Reception
Restaurant
Conference
VIP


F
FITNESS
7
701 - 736
8
814 - 836
4
401 - 436
5
501 - 536
6
601 - 636
1
101 - 119
Conference
2
201 - 236
3
301 - 336
-2
Garage
-1
Garage
0
Bar
Lobby
Reception
Restaurant
Conference
VIP


1
ABC 2
DEF 3
GHI 4
JKL 5
MNO 6
PQRS 7
TUV 8
WXYZ 9
*
0
#


Num Lock
/
*
–
7 Home
8
9 Pg Up
+
4
5
6
1 End
2
3 Pg Dn
Enter
0 Ins
. Del

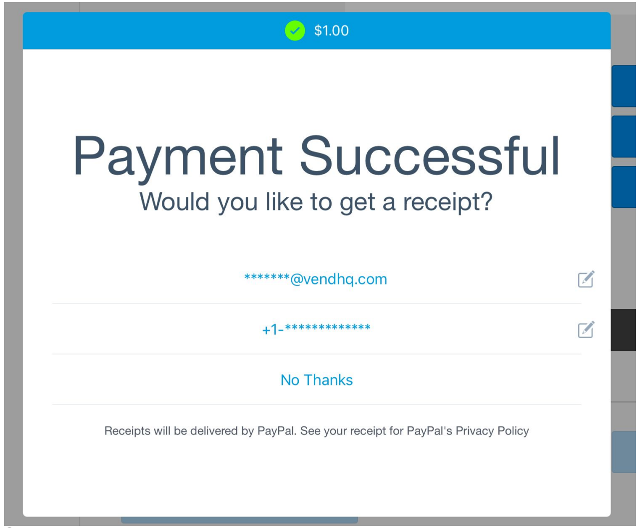
FEEDBACK

Feedback

Ever watch people at an elevator repeatedly push the Up button, or repeatedly push the pedestrian button at a street crossing?

<u>What is missing in these cases is feedback:</u> some way of letting you know that the system is working on your request.

Feedback: communicating the results of an action



Feedback

Feedback must be immediate

even a delay of a tenth of a second can be disconcerting. If the delay is too long, people often give up, going off to do other activities.

<u>Feedback must also be informative.</u>

Poor feedback can be worse than no feedback at all, because it is distracting, uninformative, and in many cases irritating and anxiety-provoking.

“My dishwasher likes to beep at three a.m. to tell me that the wash is done, defeating my goal of having it work in the middle of the night so as not to disturb anyone”

Feedback

Too many announcements cause people to ignore all of them, or wherever possible, disable all of them, which means that critical and important ones are apt to be missed.

Feedback is essential, but not when it gets in the way of other things, including a calm and relaxing environment.

<u>Notifications become useless!</u>

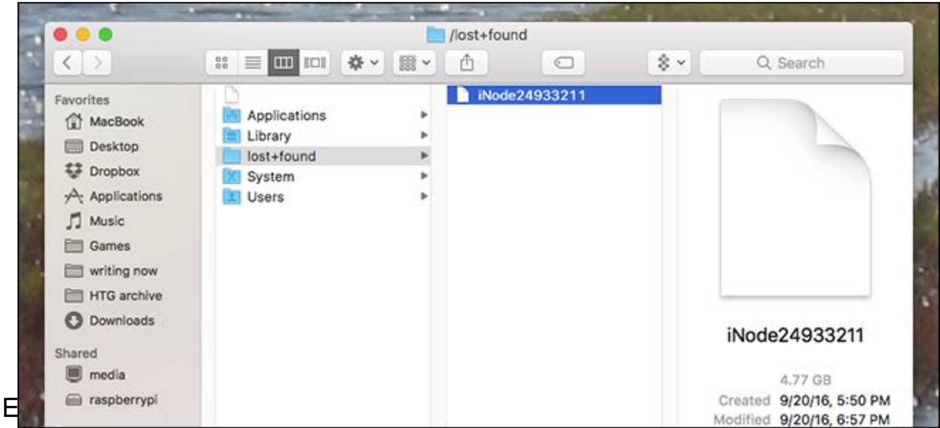
CONCEPTUAL MODEL

Conceptual Model

A conceptual model is an explanation, usually highly simplified, of how something works. It doesn't have to be complete or even accurate as long as it is useful.

The files, folders, and icons you see displayed on a computer screen help people create the conceptual model of documents and folders inside the computer, or of apps or applications residing on the screen, waiting to be summoned.

In fact, there are no folders inside the computer, those are effective conceptualizations designed to make them easier to use.



Conceptual Model

<u>Simplified models are valuable only as long as the assumptions that support them hold true.</u>

Cloud Storage Sync: files appear to be on the device. But in fact, in many cases the actual material is “in the cloud”.

The conceptual model is of one coherent storage available on all the user’s devices.

This simplified model is helpful for normal usage, but if the network connection to the cloud services is interrupted, the result can be confusing.

Files are still shown on users device screen, but users can no longer open save it

Mental Model

Mental models, are the conceptual models in people's minds that represent their understanding of how things work.

Different people may hold different mental models of the same item.

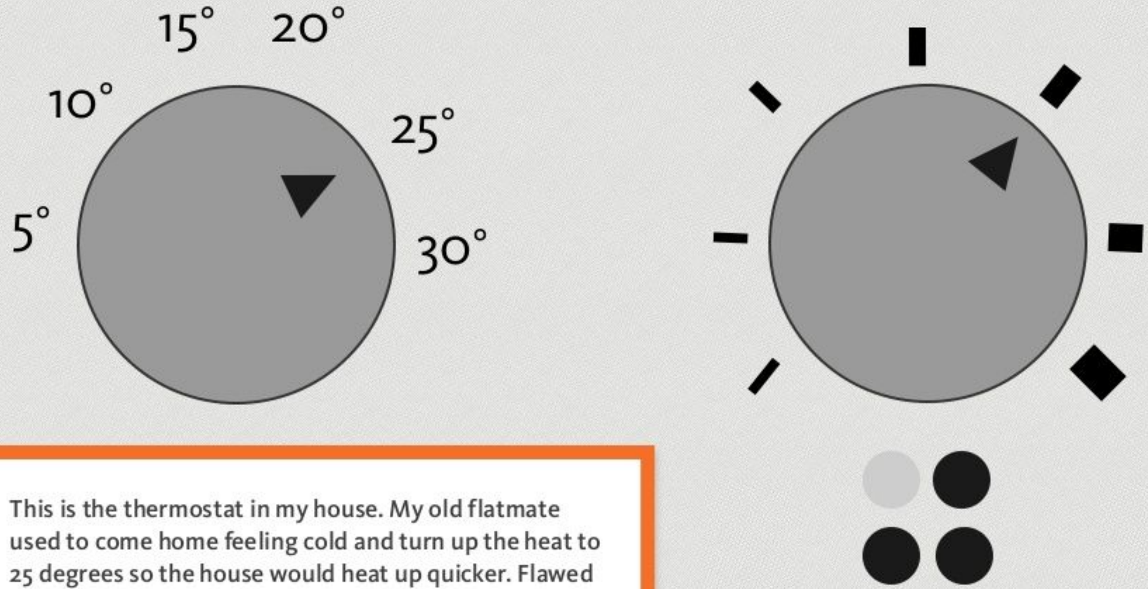
Indeed, a single person might have multiple models of the same item, each dealing with a different aspect of its operation: the models can even be in conflict.

Conceptual Model

Conceptual models are often inferred from the device itself.

Some models are passed on from person to person. Some come from manuals.

Usually the device itself offers very little assistance, so the model is constructed by experience. Quite often these models are erroneous, and therefore lead to difficulties in using the device.



This is the thermostat in my house. My old flatmate used to come home feeling cold and turn up the heat to 25 degrees so the house would heat up quicker. Flawed thinking. That's not how a thermostat works.

Compare that to a the heating element on a gas hob. It does work that way. Not flawed thinking but a flawed mental model.

MENTAL MODEL

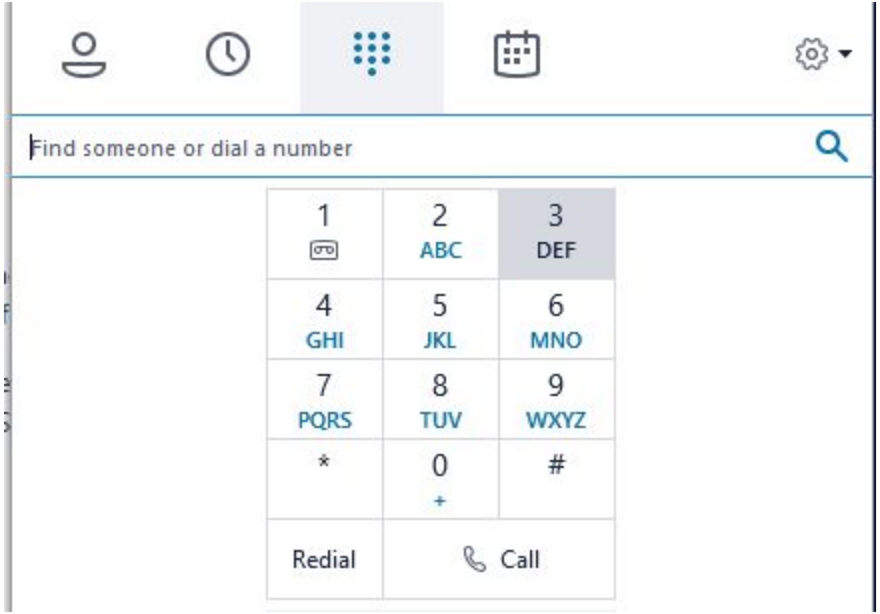
cxpartners

@mrjoe

https://www.slideshare.net/cxpartners/psychology-for-designers-or-3-predictions-from-psychology-for-the-future-of-web-design-by-mrjoe/27-mrjoe51015_2025mental_model30This_is_the

Conceptual Model

Conceptual Model



SYSTEM IMAGE

System Image

People create mental models of themselves, others, the environment, and the things with which they interact.

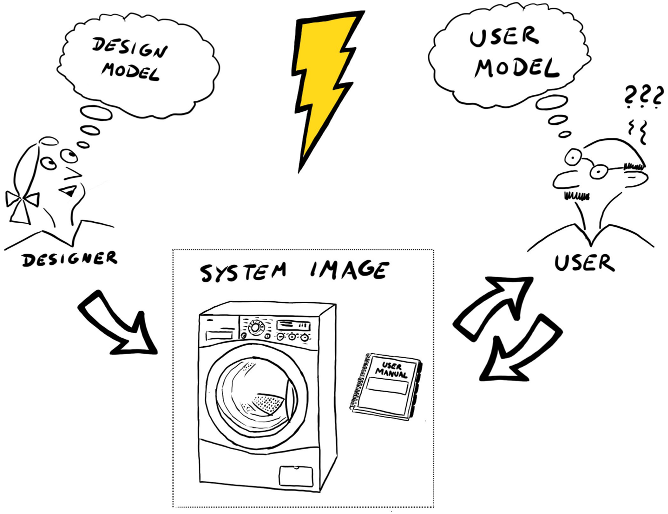
These are conceptual models formed through experience, training, and instruction.

These models serve as guides to help achieve our goals and in understanding the world.

System Image

How do we form an appropriate conceptual model for the devices we interact with?

We cannot talk to the designer, so **we rely upon whatever information is available** to us: what the device looks like, what we know from using similar things in the past, what was told to us in the sales literature, by salespeople and advertisements, by articles we may have read, by the product website and instruction manuals.



Combined information available to us is the **system image**.

System Image

When the system image is incoherent or inappropriate, then the user cannot easily use the device. If it is incomplete or contradictory, there will be trouble.

The designer's conceptual model is the designer's conception of the product, occupying one vertex of the triangle. After sale the product itself is no longer with the designer, so it is isolated as a second vertex, perhaps on the user's kitchen or wall.

The system image is what can be perceived from the physical structure that has been built

https://www.youtube.com/watch?v=shSCUNxtn18&ab_channel=LeahGreis

Example: System image of a smart Thermostat

Vimar Wifi
https://www.vimar.com/it/it/cronotermostato-touch-screen-wi-fi-da-parete-02911-video-guida-a-11721152.html

NEST https://www.youtube.com/watch?v=dHKD-9uI24I

:) https://www.youtube.com/watch?v=5yJOyKr4GBA

Changing Conventions

People invariably object and complain whenever a new approach is introduced into an existing array of products and systems.

<u>Conventions are violated -> new learning is required.</u>

The merits of the new system are irrelevant: it is the change that is upsetting.

Consistency in design is virtuous.

If a new way of doing things is only slightly better than the old, it is better to be consistent. But if there is to be a change, everybody has to change.

NB: Mixed systems are confusing to everyone!

Rethinking OS

https://uxdesign.cc/introducing-mercury-os-f4de45a04289

CONSTRAINTS, DISCOVERABILITY

CONSTRAINTS

Constraints

How do we determine how to operate something that we have never seen before? We have no choice but to **combine knowledge in the world with that in the head.**

Knowledge in the world includes perceived affordances and signifiers, the mappings between the parts that appear to be controls or places to manipulate and the resulting actions, and the physical constraints that limit what can be done.

Knowledge in the head includes conceptual models; cultural, semantic, and logical constraints on behavior; and analogies between the current situation and previous experiences with other situations.

Constraints

The sizes and shapes of the parts suggested their operation. Physical constraints limited what parts would fit together.

Cultural and semantic constraints provided strong restrictions on what would make sense for all but one of the remaining pieces, and with just one piece left and only one place it could possibly go, simple logic...

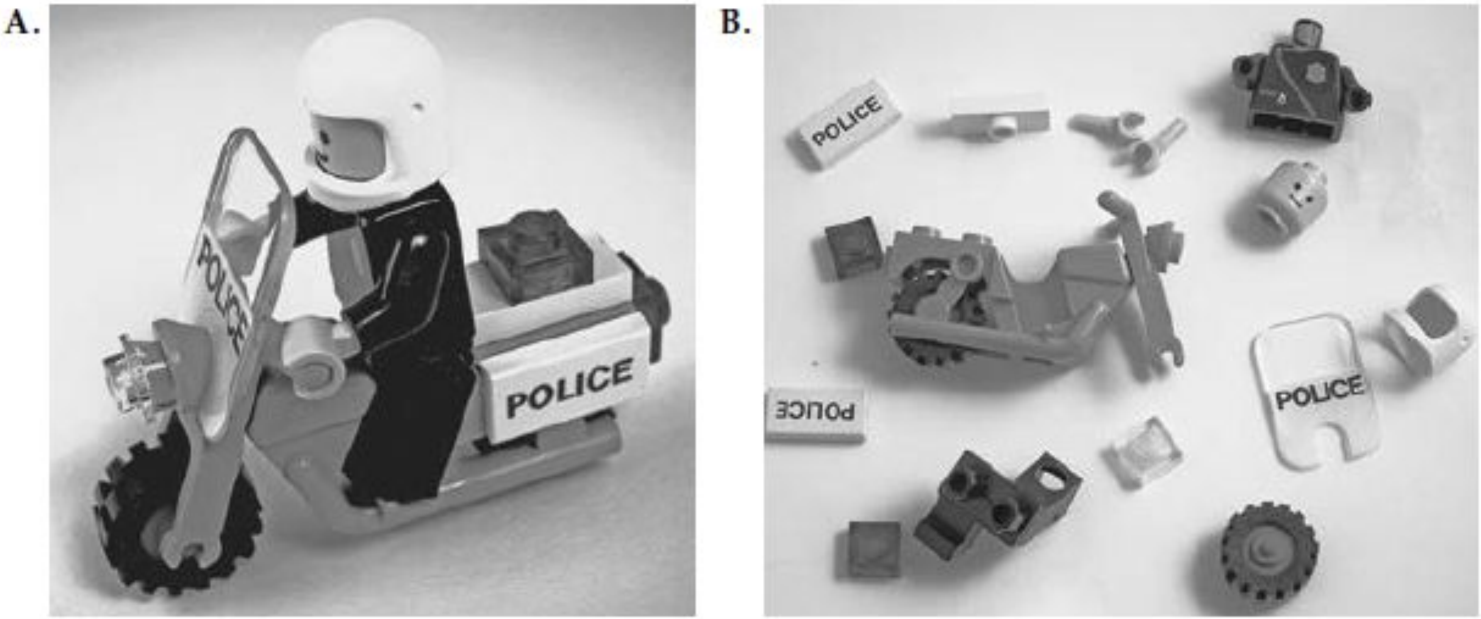
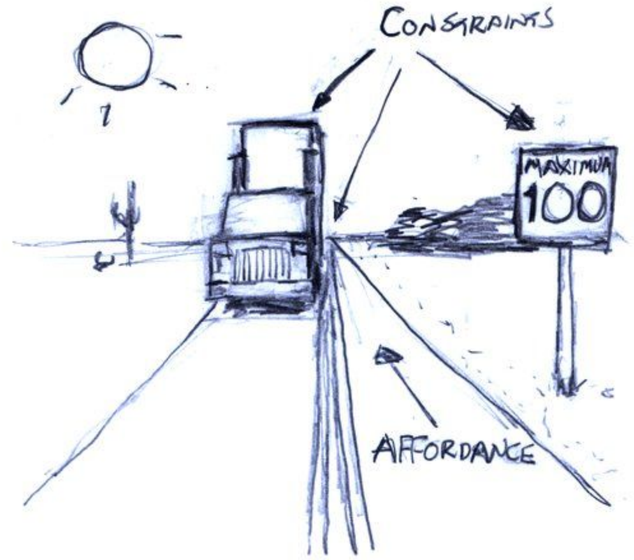


FIGURE 4.1. **Lego Motorcycle.** The toy Lego motorcycle is shown assembled (A) and in pieces (B). It has fifteen pieces so cleverly constructed that even an adult can put them together. The design exploits constraints to specify just which pieces fit where. Physical constraints limit alternative placements. Cultural and semantic constraints provide the necessary clues for further decisions. For example, cultural constraints dictate the placement of the three lights (red, blue, and yellow) and semantic constraints stop the user from putting the head backward on the body or the pieces labeled "police" upside down.

Constraints

4 classes of constraints seem to be universal, appearing in a wide variety of situations:

- physical
- cultural
- semantic
- logical



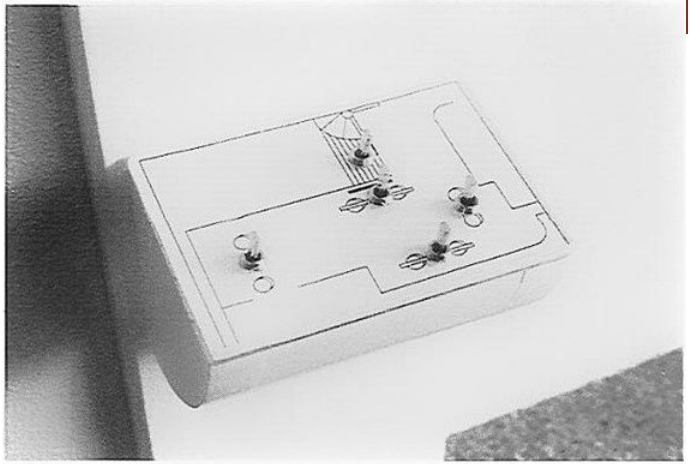
Constraints are powerful clues, limiting the set of possible actions.

The thoughtful use of constraints in design lets people readily determine the proper course of action, even in a novel situation.


Lack of constraints and mapping

The lack of clear communication among the people and organizations constructing parts of a system is perhaps the most common cause of complicated, confusing designs.

A usable design starts with careful observations of how the tasks being supported are actually performed, followed by a design process that results in a good fit to the actual ways the tasks get performed.



Constraints That Force the Desired Behavior

FORCING FUNCTIONS

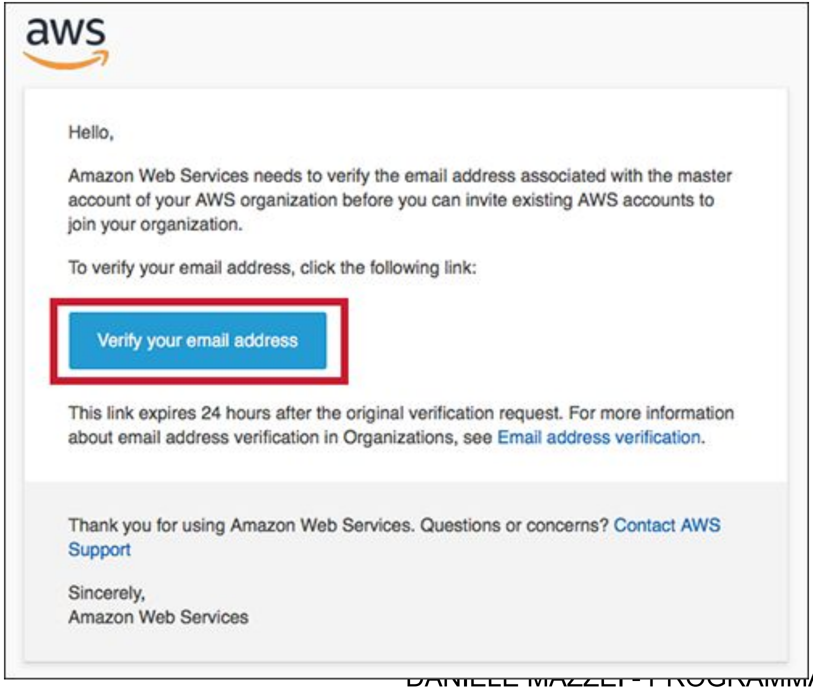
Forcing functions are a form of physical constraint: situations in which the actions are constrained so that failure at one stage prevents the next step from happening.

Forcing functions are the extreme case of strong constraints that can prevent inappropriate behavior.

Not every situation allows such strong constraints to operate, but the general principle can be extended to a wide variety of situations.

FORCING FUNCTIONS: INTERLOCKS

An interlock forces operations to take place in proper sequence.

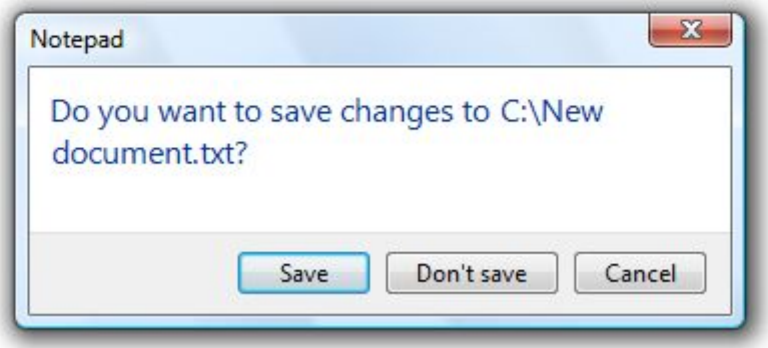


FORCING FUNCTIONS: LOCK-INS

A lock-in keeps an operation active, preventing someone from prematurely stopping it.

Standard lock-ins exist on many computer applications, where any attempt to exit the application without saving work is prevented by a message prompt asking whether that is what is really wanted

These are so effective that people uses them deliberately as standard way of exiting.
Rather than saving a file and then exiting the program



FORCING FUNCTIONS: Lockout

Whereas a lock-in keeps someone in a space or prevents an action until the desired operations have been done, a lockout prevents someone from entering a space that is dangerous, or prevents an event from occurring.

ACTIVITY-CENTERED CONTROLS

Activity-centered design (ACD) is an extension of the Human-centered design paradigm in interaction design.

ACD features heavier emphasis on the activities that a user would perform with a given piece of technology.

ACD has its theoretical underpinnings in activity theory, from which activities can be defined as actions taken by a user to achieve a goal.

It's important to note that ACD is a model, not a process. ACD is just one of many perspectives you can employ when designing.

Activity-Centered Controls

Spatial mapping [of switches] is not always appropriate.

In many cases it is better to have [switches] that control activities: **activity-centered control.**

Many auditoriums in schools and companies have computer-based controls, with switches labeled with such phrases as “video,” “computer,” “full lights,” and “lecture.”

Activity-Centered Controls

Activity-based controls are excellent in theory, but the practice is difficult to get right. When it is done badly, it creates difficulties.

Activity-Centered Controls must be User-Activity-centered

A related but wrong approach is to be device-centered rather than user-activity-centered.

When they are device-centered the user would need to know the technical model behind the system!

https://www.myharmony.com/en-en/

"To program the Harmony, I simply went to their website, selected the brand and model number of all the equipment I owned (and yes, they had every item), and then connected my remote to the computer via the convenient USB cord. In a matter of minutes, my remote was programmed."

https://jnd.org/activity-centered_design_why_i_like_my_harmony_remote_control/

I still use the specialized remotes, because specialization always beats general purpose devices. But I use the Harmony to set up, to change activities, and at the end, to turn off the equipment. Once in an activity, however, then I usually prefer to use the specialized controller, with its joystick or wheel, for quite often the physical controls of the specialized remote are superior to the general purpose ones of the harmony. But getting to that point is where the difficulty arises, and this is the problem the Harmony solves.

So, I use the harmony to select the activity and setup all the equipment to the proper state. Then I get the one remote specialized for the device -- TiVo, Satellite receiver, or DVD player. And the remote for the lights. And then I am truly happy. When finished, I pick up the harmony and one button push turns off all the equipment (see note).

How Do People Do Things

How do people do things?

It is easy to learn a few basic steps to perform operations with our technologies.

But what happens when things go wrong? How do we detect that they aren’t working, and then how do we know what to do?

To help understand this, we need to delve into **human psychology** and a simple conceptual model **of how people select and then evaluate their actions.**

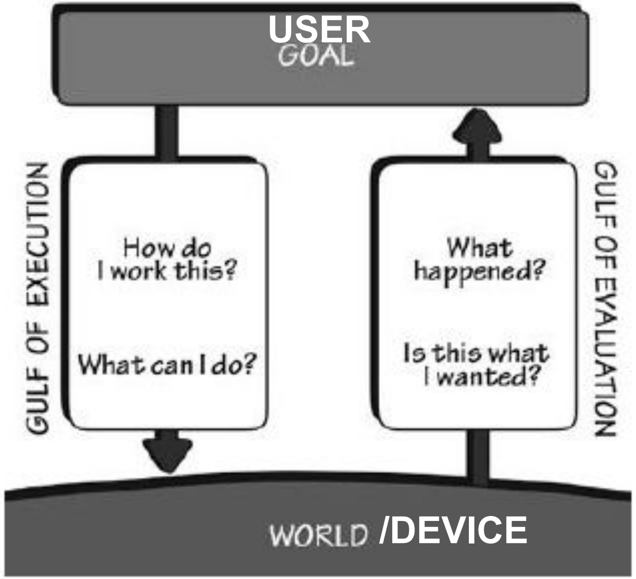
This leads the discussion to the role of understanding (via a conceptual model) and of **emotions**: **pleasure** when things work smoothly and **frustration** when our plans are thwarted.

The Gulfs of Execution and Evaluation

When people use something, they face two gulfs:

- Gulf of Execution, where they try to figure out how it operates
- Gulf of Evaluation, where they try to figure out what happened

The role of the designer is to help people bridge the two gulfs.



The Gulfs of Execution and Evaluation

The Gulf of Evaluation is typically perceived as easy to bridge, at first.

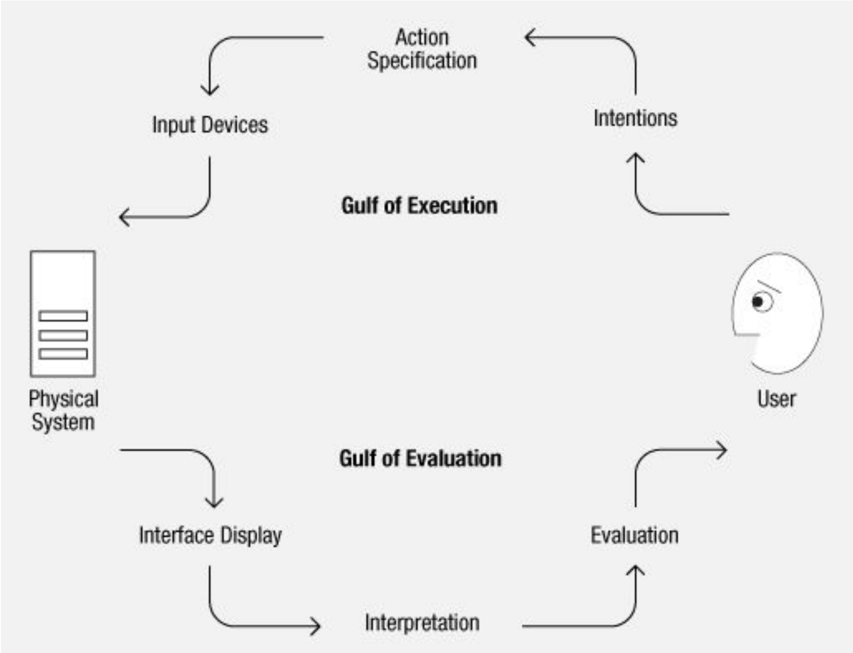
The Gulf of Evaluation reflects the amount of effort that the person must make to interpret the physical state of the device and to determine how well the expectations and intentions have been met.

The gulf is small when the device provides information about its state in a form that is easy to get, is easy to interpret, and matches the way the person thinks about the system.

The Gulfs of Execution and Evaluation

What are the major design elements that help bridge the Gulf of Execution?

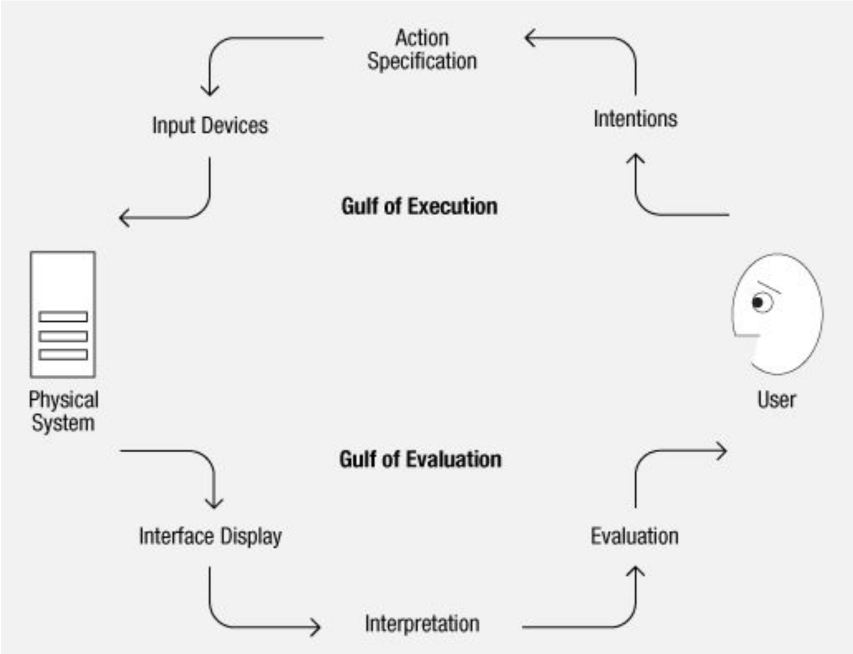
signifiers, constraints, mappings, and a conceptual model.



The Gulfs of Execution and Evaluation

What are the major design elements that help bridge the Gulf of Evaluation?

Feedback and conceptual model



People frustration

Many people do experience difficulties in using devices and UI, but explain them away by blaming themselves.

In the case of things they believe they should be capable of using they simply think, “I’m being stupid.”

Alternatively, for complicated looking devices they simply give up, deciding that they are incapable of understanding them.

Both explanations are wrong!

The difficulties reside in things design, not in the people attempting to use them.

Our Actions

There are two parts to an action:

- executing the action
- evaluating the results

doing and interpreting

Both execution and evaluation require understanding: how the item works and what results it produces.

Both execution and evaluation can affect our emotional state.

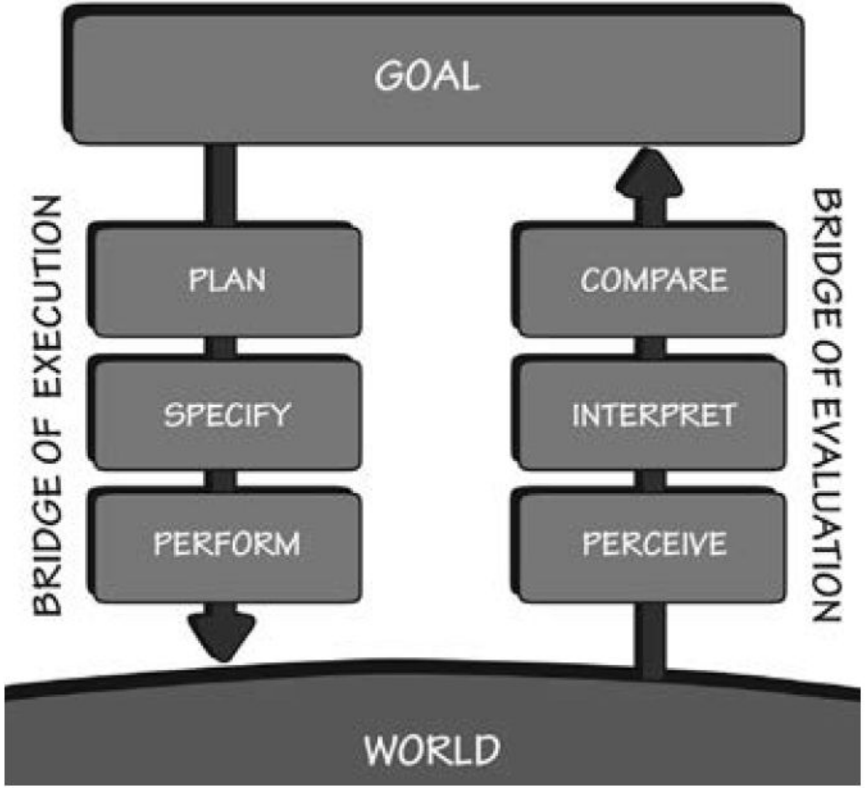
The 7 states of the action

Firstly we (1) **specify our goals** then we move to the 3 stages of execution:

2 plan
3 specify
4 perform

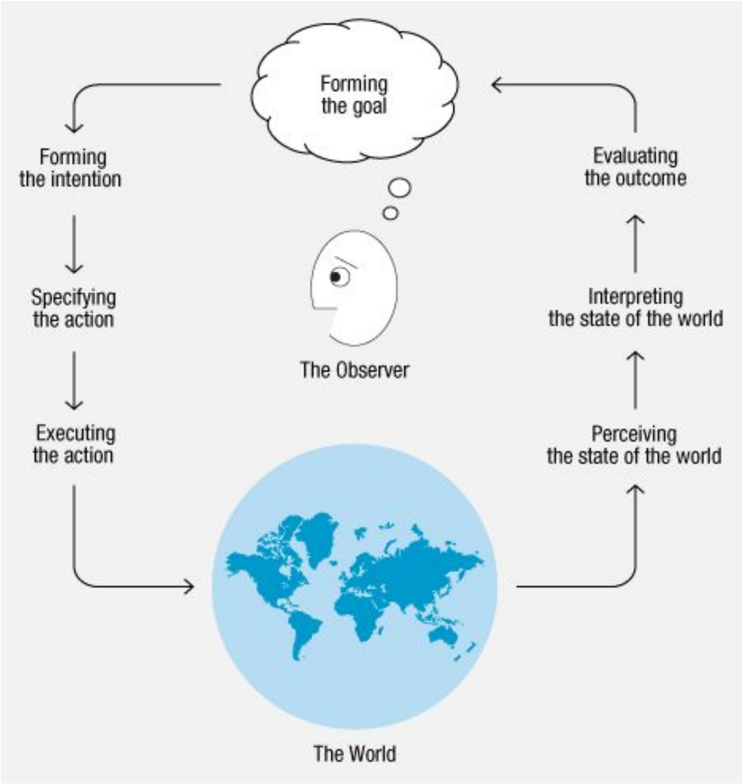
Evaluating also has 3 stages:

5 perceiving
6 interpreting
7 comparing



The 7 states of the action

1. Goal (form the goal)
2. Plan (the action)
3. Specify (an action sequence)
4. Perform (the action sequence)
5. Perceive (the state of the world)
6. Interpret (the perception)
7. Compare (the outcome with the goal)



The 7 states of the action

Most behavior does not require going through all stages in sequence

most activities will not be satisfied by single actions. There must be numerous sequences, and the whole activity may last hours or even days.

There are multiple feedback loops in which the results of one activity are used to direct further ones, in which goals lead to subgoals, and plans lead to subplans.

There are activities in which goals are forgotten, discarded, or reformulated.

The 7 states of the action

The seven stages provide a guideline for developing new products or services.

The gulfs are obvious places to start, for either gulf, whether of execution or evaluation, is an opportunity for product enhancement.

The trick is to develop observational skills to detect them

Seven Fundamental Design Principles

The seven-stage model of the action cycle can be a valuable design tool, for it provides a basic checklist of questions to ask.

In general, each stage of action requires its own special design strategies and, in turn, provides its own opportunity for disaster

<u>We can derive 7 questions that anyone using a product should always be able to answer</u>

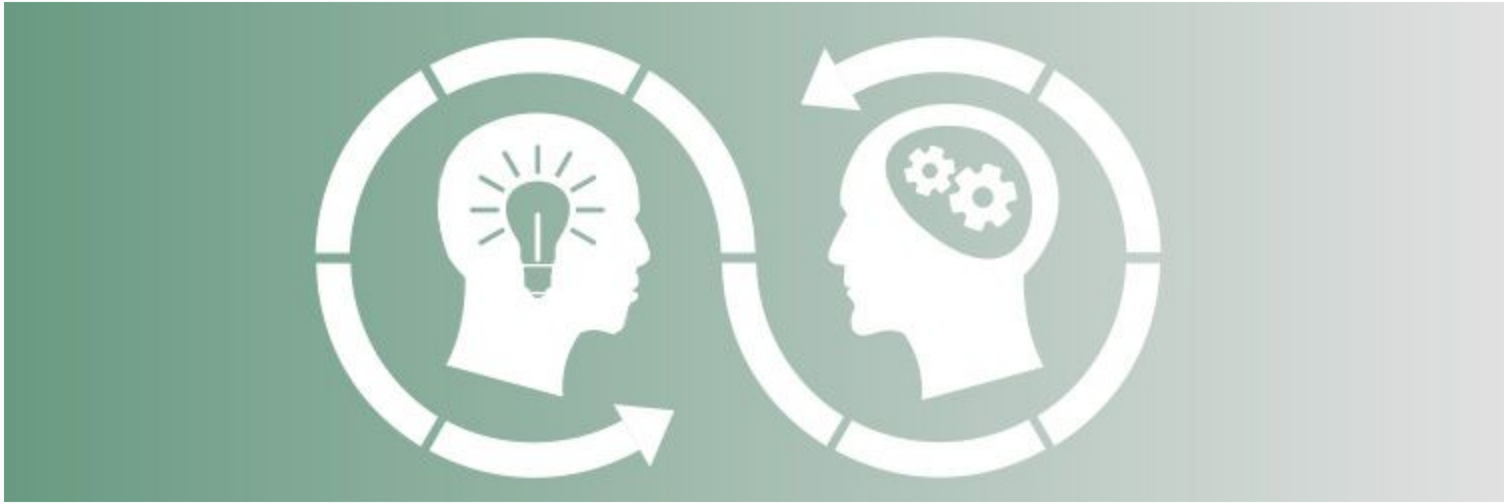
Seven Fundamental Design Principles

1. What do I want to accomplish?
2. What are the alternative action sequences?
3. What action can I do now?
4. How do I do it?
5. What happened?
6. What does it mean?
7. Is this okay? Have I accomplished my goal?

Feedforward and Feedback in interaction

The information that helps answer questions of execution (doing) is **feedforward**.

The information that aids in understanding what has happened is **feedback**.



Feedforward and Feedback in interaction

Feedforward is accomplished through **appropriate use of signifiers, constraints, and mappings.** The conceptual model plays an important role.

Feedback is accomplished through explicit information about **the impact of the action**. Once again, the conceptual model plays an important role.

Both feedback and feedforward need to be presented in a form that is readily interpreted by the people using the system.

The seven fundamental principles of design

The insights from the seven stages of action lead us to seven fundamental principles of design:

1. **Discoverability.** It is possible to determine what actions are possible and the current state of the device.
2. **Feedback.** There is full and continuous information about the results of actions and the current state of the product or service. After an action has been executed, it is easy to determine the new state.
3. **Conceptual model.** The design projects all the information needed to create a good conceptual model of the system, leading to understanding and a feeling of control. The conceptual model enhances both discoverability and evaluation of results.

The seven fundamental principles of design

4. **Affordances.** The proper affordances exist to make the desired actions possible.

5. **Signifiers.** Effective use of signifiers ensures discoverability and that the feedback is well communicated and intelligible.

6. **Mappings.** The relationship between controls and their actions follows the principles of good mapping, enhanced as much as possible through spatial layout and temporal contiguity.

7. **Constraints.** Providing physical, logical, semantic, and cultural constraints guides actions and eases interpretation.

Opportunistic actions

For many everyday tasks, goals and intentions are not well specified: they are opportunistic rather than planned.

Opportunistic actions are those in which the behavior takes advantage of circumstances.

Rather than engage in extensive planning and analysis, we go about the day's activities and do things as opportunities arise.

Thus, we may not have planned to try a new café or to ask a question of a friend.

Opportunistic actions

Opportunistic actions are less precise and certain than specified goals and intentions, but they result in less mental effort, less inconvenience, and perhaps more interest.

Human Thought

Human Thought: Mostly Subconscious

The human mind is immensely complex. Despite many advances in our understanding, much still remains mysterious, yet to be learned.

One of the mysteries concerns the nature of and distinction between those activities that are conscious and those that are not.

Most of the brain's operations are subconscious, hidden beneath our awareness. It is only the highest level, what I call reflective, that is conscious.

Conscious attention is necessary to learn most things, but after the initial learning, continued practice and study, sometimes for thousands of hours over a period of years, produces what psychologists call "overlearning," Once skills have been overlearned, performance appears to be effortless, done automatically, with little or no awareness.

Human Thought: Mostly Subconscious

In the house you lived in three houses ago, as you entered the front door, was the doorknob on the left or right?

Now you have to engage in conscious, reflective problem solving, first to retrieve just which house is being talked about, and then what the correct answer is.

Most people can determine the house, but have difficulty answering the question because they can readily imagine the doorknob on both sides of the door.

The way to solve this problem is to imagine doing some activity, such as walking up to the front door while carrying heavy packages with both hands: how do you open the door? Alternatively, visualize yourself inside the house, rushing to the front door to open it for a visitor.

Conscious vs Subconscious thought

Subconscious thought matches patterns, finding the best possible match of one's past experience to the current one. It proceeds rapidly and automatically, without effort.

Subconscious processing is one of our strengths. It is good at detecting general trends, at recognizing the relationship between what we now experience and what has happened in the past.

Conscious thought is quite different. It is slow and labored. Here is where we slowly ponder decisions, think through alternatives, compare different choices. Conscious thought considers first this approach, then that—comparing, rationalizing, finding explanations. Formal logic, mathematics, decision theory: these are the tools of conscious thought.

TABLE 2.1. Subconscious and Conscious Systems of Cognition

Subconscious	Conscious
Fast	Slow
Automatic	Controlled
Multiple resources	Limited resources
Controls skilled behavior	Invoked for novel situations: when learning, when in danger, when things go wrong

Declarative Vs Procedural memory

All these tasks involve long-term memory, but in very different ways.

Questions like *“What is the capital of Brazil?”* require retrieving factual information, what is called **declarative memory.**

The door knob position question could have been answered factually, but is usually most easily answered by recalling the activities performed to open the door. This is called **procedural memory.**

Emotions and cognition

Emotion interacts with cognition biochemically with hormones modifying the behavior of brain cells. Hormones exert powerful biases on brain operation.

Thus, in tense, threatening situations, the emotional system triggers the release of hormones that bias the brain to focus upon relevant parts of the environment.

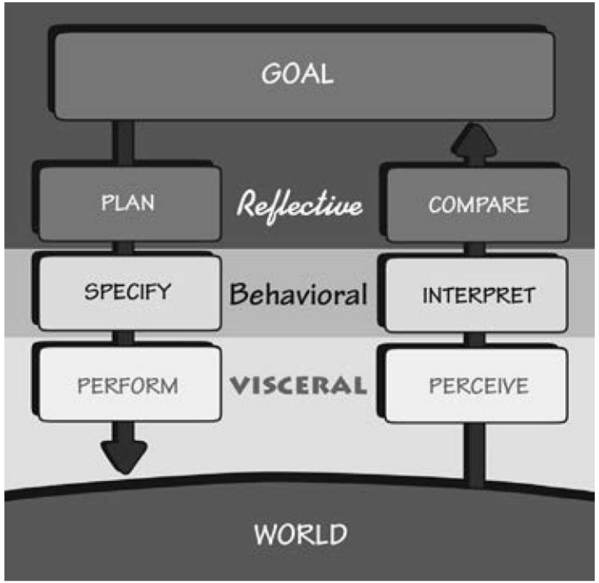
In calm, non-threatening situations, the emotional system triggers the release of hormones that relax the muscles and bias the brain toward exploration and creativity.

Now the brain is more apt to notice changes in the environment, to be distracted by events, and to piece together events and knowledge that might have seemed unrelated earlier.

A positive emotional state is ideal for creative thought, but it is not very well suited for getting things done.

Three Levels of Processing

A gross oversimplification of the brain processing is based on the splitting of the brain in 3 procedural levels: Visceral, behavioral and reflective.



visceral level (the lizard brain) These is part of the basic protective mechanisms of the human affective system, making quick judgments about the environment: good or bad, safe or dangerous.

The visceral system allows us to respond quickly and subconsciously, without conscious awareness or control.

The basic biology of the visceral system minimizes its ability to learn. Visceral learning takes place primarily by sensitization or desensitization. Visceral responses are fast and automatic.

Visceral level

For designers, the visceral response is about immediate perception: the pleasantness of a mellow, harmonious sound or the jarring, irritating scratch of fingernails on a rough surface.

Here is where the style matters: appearances, whether sound or sight, touch or smell, drive the visceral response. This has nothing to do with how usable, effective, or understandable the product is. It is all about attraction or repulsion. Great designers use their aesthetic sensibilities to drive these visceral responses.

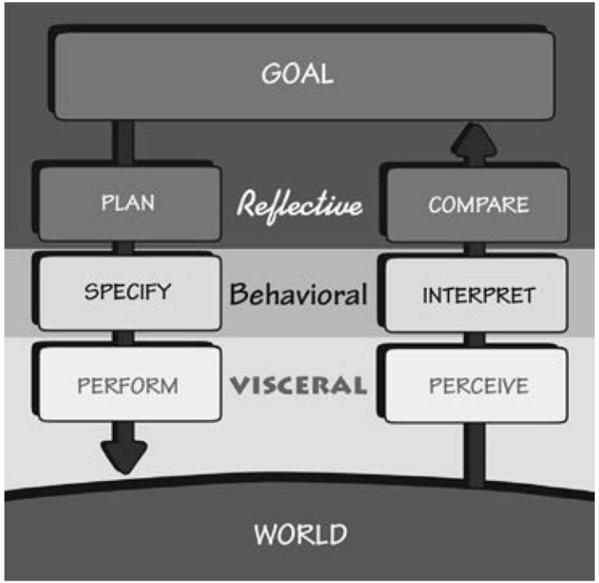
Engineers and other logical people tend to dismiss the visceral response as irrelevant. Engineers are proud of the inherent quality of their work and dismayed when inferior products sell better “just because they look better.” But all of us make these kinds of judgments, even those very logical engineers.

Three Levels of Processing

The **behavioral level** is the home of learned skills, triggered by situations that match the appropriate patterns.

Actions and analyses at this level are largely subconscious. Even though we are usually aware of our actions, we are often unaware of the details.

When we speak, we often do not know what we are about to say until our conscious mind (the reflective part of the mind) hears ourselves uttering the words.



Behavioral level

For designers, the most critical aspect of the behavioral level is that every action is associated with an expectation. Expect a positive outcome and the result is a positive affective response (a “positive valence,” in the scientific literature).

Expect a negative outcome and the result is a negative affective response (a negative valence): dread and hope, anxiety and anticipation.

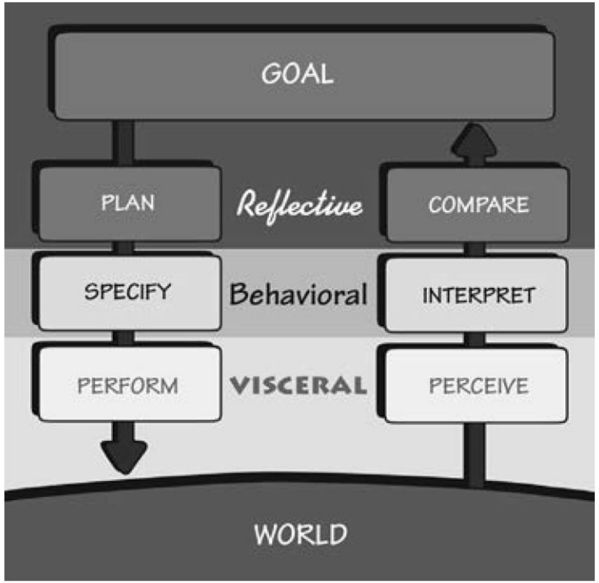
The information in the feedback loop of evaluation confirms or disconfirms the expectations, resulting in satisfaction or relief, disappointment or frustration.

Behavioral states are learned. They give rise to a feeling of control when there is good understanding and knowledge of results, and frustration and anger when things do not go as planned

Feedback is critical to managing expectations

Three Levels of Processing

The **reflective level** is the home of conscious cognition. As a consequence, this is where deep understanding develops, where reasoning and conscious decision-making take place.



The visceral and behavioral levels are subconscious and, as a result, they respond rapidly, but without much analysis. Reflection is cognitive, deep, and slow.

It often occurs after the events have happened.

The highest levels of emotions come from the reflective level, for it is here that causes are assigned and where predictions of the future take place. Adding causal elements to experienced events leads to such emotional states as guilt and pride (when we assume ourselves to be the cause) and blame and praise (when others are thought to be the cause).

Reflective level

To the designer, reflection is perhaps the most important of the levels of processing.

Reflection is conscious, and the emotions produced at this level are the most protracted: those that assign agency and cause, such as guilt and blame or praise and pride.

Reflective responses are part of our memory of events. Memories last far longer than the immediate experience or the period of usage, which are the domains of the visceral and behavioral levels.

It is reflection that drives us to recommend a product, to recommend that others use it—or perhaps to avoid it.

Reflective memories are often more important than reality.

Human Error and Mitigation Strategies

Human Error

<u>Most industrial accidents are caused by human error:</u> estimates range between 75 and 95 percent.

How is it that so many people are so incompetent?

Answer: **They aren't. It's a design problem.**

Why?

We design equipment that requires people to be fully alert and attentive for hours, or to remember archaic, confusing procedures even if they are only used infrequently, sometimes only once in a lifetime.

We put people in boring environments with nothing to do for hours on end, until suddenly they must respond quickly and accurately.

Or we subject them to complex, high-workload environments, where they are continually interrupted while having to do multiple tasks simultaneously.

Why?

Interruptions are a common reason for error, not helped by designs and procedures that assume full, dedicated attention yet that do not make it easy to resume operations after an interruption.

Human attitude towards errors

“We caught the culprit.”

But it doesn’t cure the problem: the same error will occur over and over again. Instead, when an error happens, we should determine why, then redesign the product or the procedures being followed so that it will never occur again or, if it does, so that it will have minimal impact.

ROOT CAUSE ANALYSIS

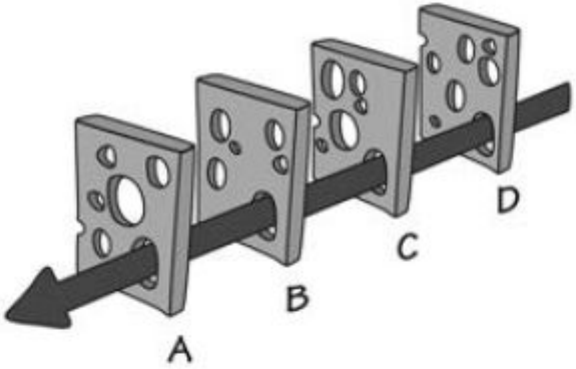
investigate the accident until the single, underlying cause is found.

What this ought to mean is that when people have indeed made erroneous decisions or actions, we should determine what caused them to err.

This is what root cause analysis ought to be about. Alas, all too often it stops once a person is found to have acted inappropriately.

most accidents do not have a single cause:
there are usually multiple things that went wrong

This is what James Reason has called the
“Swiss cheese model of accidents”



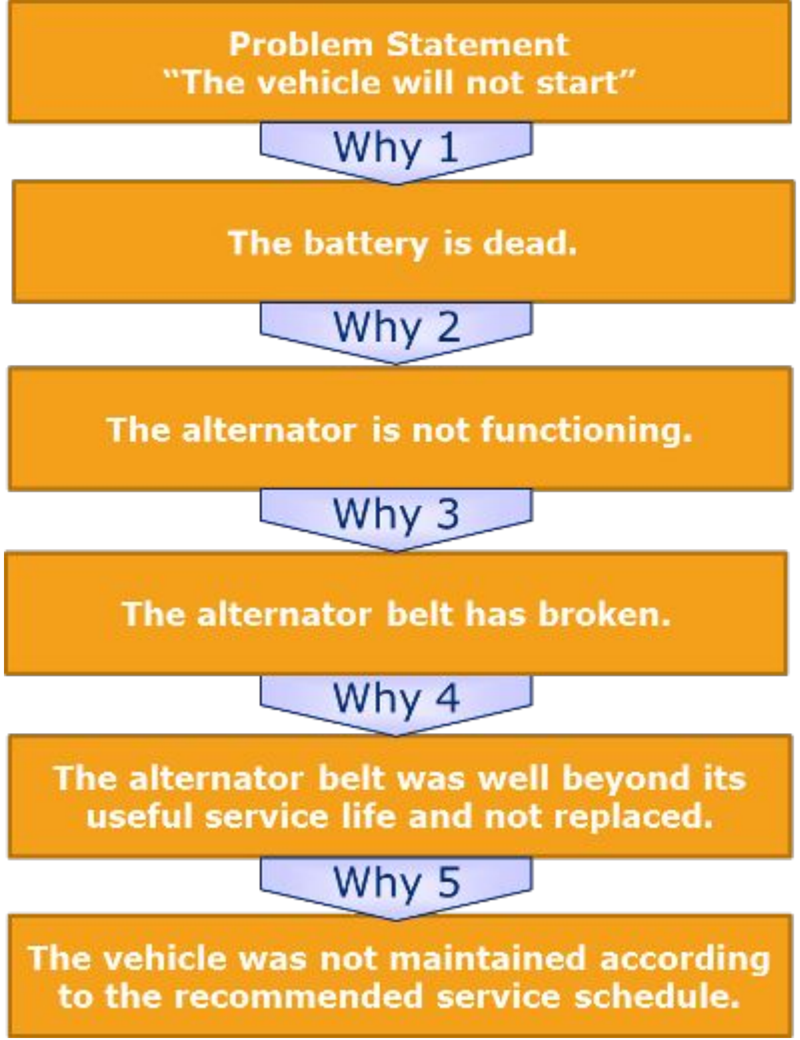
THE FIVE WHYS

originally developed by Sakichi Toyoda and used by the Toyota Motor Company as part of the Toyota Production System for improving quality.

Today it is widely deployed. Basically, it means that when searching for the reason, even after you have found one, do not stop: ask why that was the case.

And then ask why again. Keep asking until you have uncovered the true underlying causes.

Does it take exactly five? No, but calling the procedure “Five Whys” emphasizes the need to keep going even after a reason has been found.




5 REASONS TO USE 5 WHYS
IDENTIFY THE CAUSE, NOT JUST THE SYMPTOMS
Dig deep and find the underlying issues that led to the problem rather than using a quick-fix solution or playing the blame game.
PERFORM AN EVIDENCE-BASED ANALYSIS
Don't assume or jump to conclusions about the source of the problem - make sure you have proof that it's the cause, every step of the way.
ELIMINATE ISSUES IN YOUR SYSTEM FOR GOOD
Be proactive rather than reactive. When issues arise, prevent their reoccurrence to save time and increase the quality of your system.
SEEK IMPROVEMENTS AND WELCOME CHANGE
Encourage your stakeholders to constantly seek ways to improve and adapt your process to ensure its long-term success.
BUILD A CULTURE THAT EMBRACES PROGRESS
Encourage your team to raise issues and concerns without fear or judgement, and to seek long-term solutions rather than the easy way out.
POWERNOODLE®
BETTER QUALITY DECISIONS
POWERNOODLE.COM/MODELS-ARTICLE/5-WHYS

People attitude toward errors

We can’t fix problems unless people admit they exist.

When we blame people, it is then difficult to convince organizations to restructure the design to eliminate these problems.

Why do people err?

Because the designs focus upon the requirements of the system and the machines, and not upon the requirements of people.

Most machines require precise commands and guidance, forcing people to enter numerical information perfectly.

But people aren’t very good at great precision.

People are creative, constructive, exploratory beings. We are particularly good at novelty, at creating new ways of doing things, and at seeing new opportunities. Dull, repetitive, precise requirements fight against these traits.

DEFINITIONS: ERRORS

Human error is defined as any deviance from “appropriate” behavior.

The word appropriate is in quotes because in many circumstances, the appropriate behavior is not known or is only determined after the fact. B t still, error is defined as deviance from the generally accepted correct or appropriate behavior.

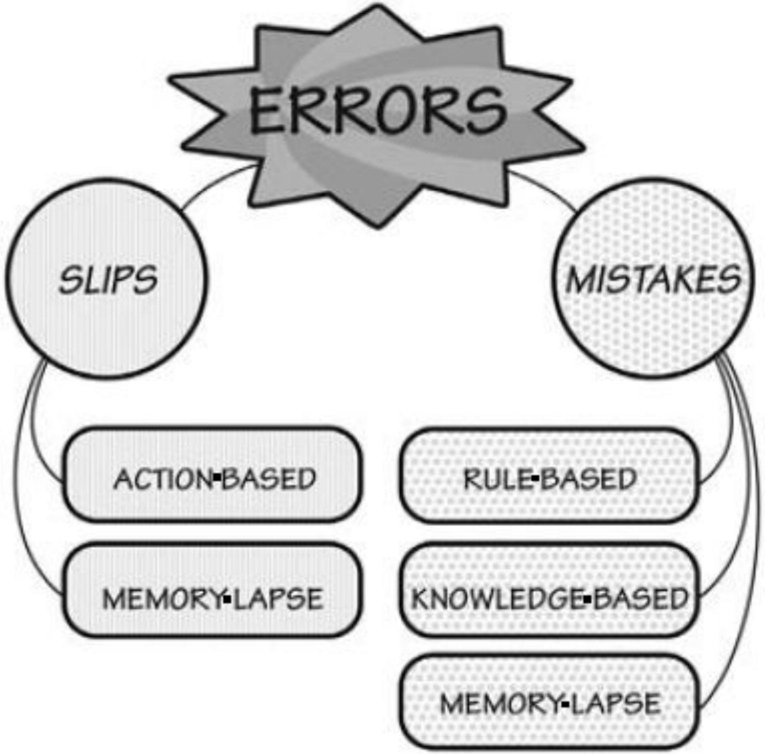
Error is the general term for all wrong actions.

Slips and Mistakes

There are two major classes of error:

slips (lapsus)

mistakes (errori cognitivi)



SLIPS (lapsus)

A slip occurs when a person intends to do one action and ends up doing something else.

With a slip, the action performed is not the same as the action that was intended.

There are two major classes of slips: action-based and memory-lapse.

In action-based slips, the wrong action is performed.

In memory lapses, memory fails, so the intended action is not done or its results not evaluated.

Slips (lapsus)

Example of an action-based slip. I poured some milk into my coffee and then put the coffee cup into the refrigerator. This is the correct action applied to the wrong object.

Example of a memory-lapse slip. I forget to turn off the gas burner on my stove after cooking dinner.

Mistakes (cognitive errors)

A mistake occurs when the wrong goal is established or the wrong plan is formed. From that point on, even if the actions are executed properly they are part of the error, because the actions themselves are inappropriate; they are part of the wrong plan.

With a mistake, the action that is performed matches the plan: **it is the plan that is wrong**

Mistakes (cognitive errors)

In a **rule-based mistake**, the person has appropriately diagnosed the situation, but then decided upon an erroneous course of action: the wrong rule is being followed.

In a **knowledge-based** mistake, the problem is misdiagnosed because of erroneous or incomplete knowledge.

Memory-lapse mistakes take place when there is forgetting at the stages of goals, plans, or evaluation. **(dimenticanza)**

Mistakes (cognitive errors)

Example of **rule-based mistakes**. A mechanic diagnosed a defect on a car battery but decided to do not replace the battery because still working at 50% of performances

Example of **knowledge-based mistake**. Weight of fuel was computed in pounds instead of kilograms.

Example of **memory-lapse mistake**. A mechanic failed to complete troubleshooting because of forget a step.

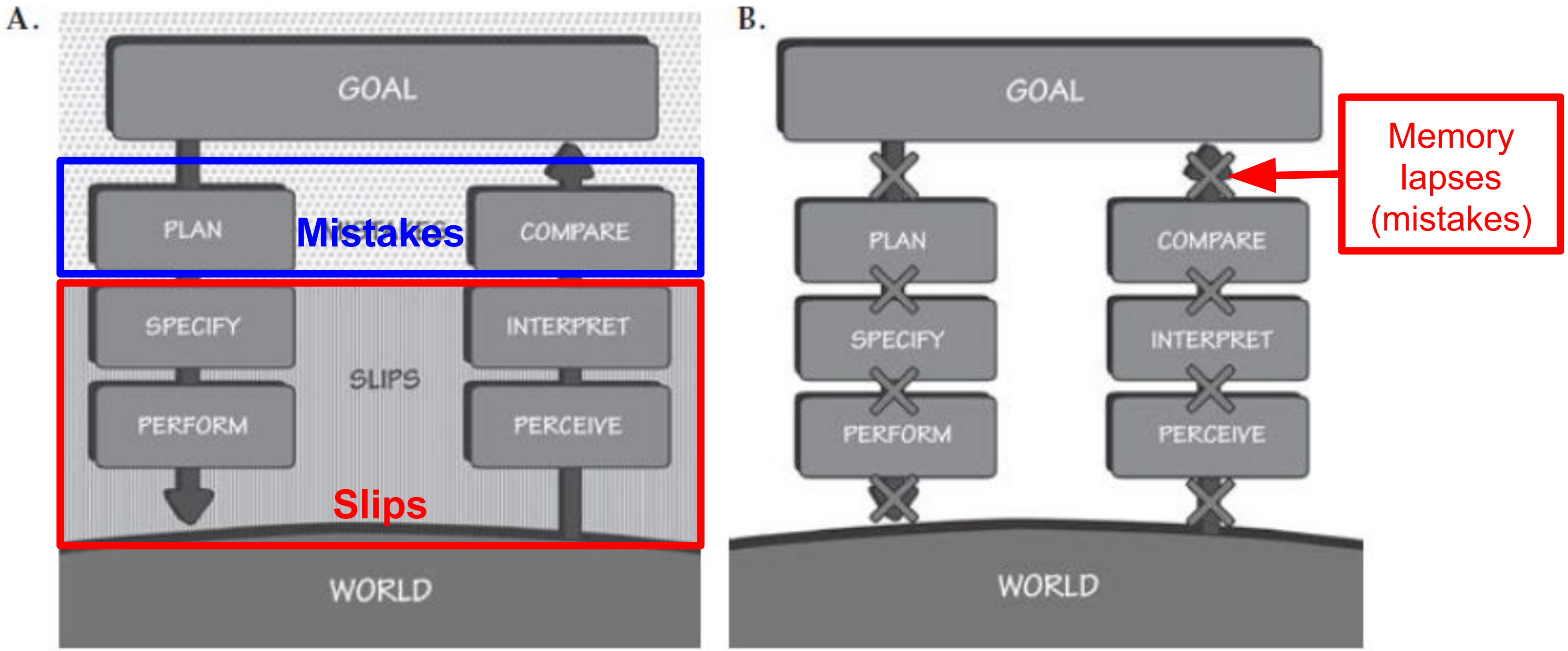


FIGURE 5.2. Where Slips and Mistakes Originate in the Action Cycle. Figure A shows that action slips come from the bottom four stages of the action cycle and mistakes from the top three stages. Memory lapses impact the transitions between stages (shown by the X's in Figure B). Memory lapses at the higher levels lead to mistakes, and lapses at the lower levels lead to slips.

Slips and Mistakes

- novices are more likely to make mistakes than slips
- experts are more likely to make slips and mistakes-memory lapses (dimenticanza).

Mistakes often arise from ambiguous or unclear information about the current state of a system, the lack of a good conceptual model, and inappropriate procedures.

most mistakes result from erroneous choice of goal or plan or erroneous evaluation and interpretation.

All of these come about through poor information provided by the system about the choice of goals and the means to accomplish them (plans), and poor-quality feedback about what has actually happened.

Interruptions

A major source of error, especially memory-lapse errors, is interruption.

When an activity is interrupted by some other event, the cost of the interruption is far greater than the loss of the time required to deal with the interruption: it is also the cost of resuming the interrupted activity.

To resume, it is necessary to remember precisely the previous state of the activity: what the goal was, where one was in the action cycle, and the relevant state of the system.

Most systems make it difficult to resume after an interruption.

wrong feedbacks

Unnecessary, annoying alarms occur in numerous situations. How do people cope? By disconnecting warning signals, silencing bells etc

The problem comes after such alarms are disabled, either when people forget to restore the warning systems (there are those memory-lapse slips again), or if a different incident happens while the alarms are disconnected.

At that point, nobody notices.

Warnings and safety methods must be used with care and intelligence, taking into account the tradeoffs for the people who are affected.

The design of warning signals is surprisingly complex.

Speech as feedback

More and more of our machines present information through speech. But like all approaches, this has both strengths and weaknesses.

It allows for precise information to be conveyed, especially when the person’s visual attention is directed elsewhere.

But if several speech warnings operate at the same time, or if the environment is noisy, speech warnings may not be understood. Or if conversations among the users or operators are necessary, speech warnings will interfere.

Speech warning signals can be effective, but only if used intelligently.

Error prevention

It should not be possible for one simple error to cause widespread damage.

Here is what should be done:

- **Understand** the causes of error and design to minimize those causes.
- **Do sensibility checks.** Does the action pass the “common sense” test?
- **Make it possible to reverse actions**—to “undo” them—or make it harder to do what cannot be reversed.
- Make it **easier for people to discover the errors** that do occur, and make them easier to correct.
- **Don’t treat the action as an error**; rather, try to help the person complete the action properly. Think of the action as an approximation to what is desired.

ADDING CONSTRAINTS TO BLOCK ERRORS

Prevention often involves adding specific constraints to actions. In the physical world, this can be done through clever use of shape and size (bocchettone benzina/diesel).

Electronic systems have a wide range of methods that could be used to reduce error. One is to **segregate controls**, so that easily confused controls are located far from one another.

Another is to use **separate modules**, so that any control not directly relevant to the current operation is not visible on the screen, but requires extra effort to get to.

UNDO

Perhaps the most powerful tool to minimize the impact of errors is the Undo command in modern electronic systems, reversing the operations performed by the previous command, wherever possible.

The best systems have multiple levels of undoing, so it is possible to undo an entire sequence of actions.

CONFIRMATION AND ERROR MESSAGES

Many systems try to prevent errors by requiring confirmation before a command will be executed, especially when the action will destroy something of importance.

But these requests are usually ill-timed because after requesting an operation, people are usually certain they want it done.

A better check would be a prominent display of both the action to be taken and the object, perhaps with the choice of “cancel” or “do it.”

The important point is making salient what the implications of the action are.

> *Person: Delete “my most important file.”*
> *System: Do you want to delete “my most important file”?*
> *Person: Yes.*
> *System: Are you certain?*
> *Person: Yes!*
> *System “My most favorite file” has been deleted.*
> *Person: Oh. Damn.*

Warning messages are surprisingly ineffective against mistakes

CONFIRMATION AND ERROR MESSAGES

What can a designer do?

• Make the item being acted upon more prominent. That is, change the appearance of the actual object being acted upon to be more visible: enlarge it, or perhaps change its color.

• Make the operation reversible. If the person saves the content, no harm is done except the annoyance of having to reopen the file. If the person elects Don’t Save, the system could secretly save the contents, and the next time the person opened the file, it could ask whether it should restore it to the latest condition.

SENSIBILITY CHECKS

Electronic systems have another advantage over mechanical ones: they can check to make sure that the requested operation is sensible.

Suppose I wanted to transfer $1,000 into a Korean bank account in won ($1,000 is roughly ₩1,000,000). But suppose I enter the Korean number into the dollar field.

Oops—I'm trying to transfer a million dollars. Intelligent systems would take note of the normal size of my transactions, querying if the amount was considerably larger than normal.

MINIMIZING SLIPS

Slips most frequently occur when the **conscious mind is distracted**, either by some other event or simply because the action being performed is so well learned that it can be done automatically, without conscious attention. As a result, the person **does not pay sufficient attention to the action** or its consequences.

It might therefore seem that one way to minimize slips is to ensure that people always pay close, conscious attention to the acts being done.

Bad idea!

Skilled behavior is subconscious, which means it is fast, effortless, and usually accurate.

MINIMIZING SLIPS

Many slips can be minimized by **ensuring that the actions and their controls are as dissimilar as possible**, or at least, as physically far apart as possible.

The best way of mitigating slips is to provide perceptible feedback about the nature of the action being performed, then very perceptible feedback describing the new resulting state, coupled with a mechanism that allows the error to be undone.

For example, the use of machine-readable codes has led to a dramatic reduction in the delivery of wrong medications to patients.

(These scans do increase the workload, but only slightly. Other kinds of errors are still possible, but these simple steps have already been proven worthwhile.)

MINIMIZING SLIPS

Common engineering and design practices seem as if they are deliberately intended to cause slips.

Rows of identical controls or meters is a sure recipe for description-similarity errors.

Situations with numerous interruptions, yet where the design assumes undivided attention, are a clear enabler of memory lapses—and almost no equipment today is designed to support the numerous interruptions that so many situations entail.

Procedures should be designed so that the initial steps are as dissimilar as possible.

Error mitigation

The Swiss cheese metaphor suggests several ways to reduce accidents:

• Add more slices of cheese.

• Reduce the number of holes (or make the existing holes smaller).

• Alert the human operators when several holes have lined up.

Each of these has operational implications:

More slices of cheese means mores lines of defense **(more checks and control steps)**

Reducing the number of critical safety points where error can occur is like reducing the number or size of the holes **(Reduce distraction and design for error mitigation)**

Design Principles for Dealing with Error

People are flexible, versatile, and creative. Machines are rigid, precise, and relatively fixed in their operations. There is a mismatch between the two,

Difficulties arise when we do not think of people and machines as collaborative systems, but assign whatever tasks can be automated to the machines and leave the rest to people. This ends up requiring people to behave in machine like fashion, in ways that differ from human capabilities.

We expect people to monitor machines, which means keeping alert for long periods, something we are bad at.

Design Principles for Dealing with Error

What we call “human error” is often simply a human action that is inappropriate for the needs of technology. As a result, it flags a deficit in our technology. It should not be thought of as error.

We should eliminate the concept of error: instead, we should realize that people can use assistance in translating their goals and plans into the appropriate form for technology.

Therefore, the best designs take that fact as given and seek to minimize the opportunities for errors while also mitigating the consequences. Assume that every possible mishap will happen, so protect against them.

key design principles

• **Put the knowledge required to operate the technology in the world.** Don't require that all the knowledge must be in the head. Allow for efficient operation when people have learned all the requirements, when they are experts who can perform without the knowledge in the world, but make it possible for non-experts to use the knowledge in the world. This will also help experts who need to perform a rare, infrequently performed operation or return to the technology after a prolonged absence.

• **Use the power of natural and artificial constraints:** physical, logical, semantic, and cultural. Exploit the power of forcing functions and natural mappings.

key design principles

- **Bridge the two gulfs,** the Gulf of Execution and the Gulf of Evaluation. Make things visible, both for execution and evaluation. On the execution side, provide feedforward information: make the options readily available. On the evaluation side, provide feedback: make the results of each action apparent. Make it possible to determine the system’s status readily, easily, accurately, and in a form consistent with the person’s goals, plans, and expectations.

https://uxdesign.cc/how-to-prevent-your-users-from-making-mistakes-d641c6260b29

Le Interfacce utente

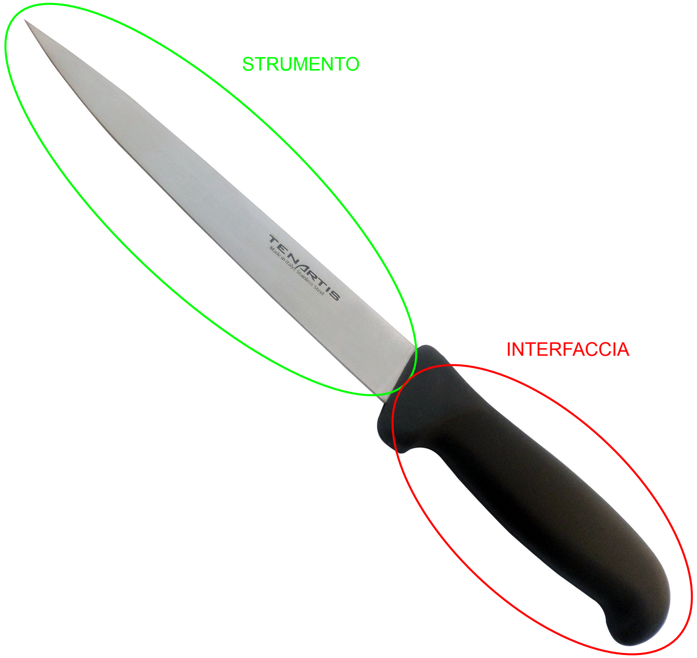
Le interfacce utente

Un'interfaccia è qualcosa che sta fra due facce.

E' il punto di contatto fra due sistemi che tentano di comunicare.

Le interfacce possono far comunicare due macchine fra loro oppure possono far comunicare l’uomo con la macchina

Lo strumento è ciò che fa qualcosa, l’interfaccia è ciò che serve per guidarlo nell'esecuzione dell'azione.



Le interfacce utente

Quando parliamo di Interfaccia Utente (User Interface o UI) intendiamo lo spazio di un sistema dove avviene l'interazione fra uomo-macchina.

Tipicamente, si parla di UI in ambito informatico e tecnologico e quindi le interfacce utente sono comunemente identificate come sistemi atti a mettere in comunicazione l'uomo computer, sistemi informatici e oggetti intelligenti.

Le interfacce utente

“User interfaces are a mapping from the sensory, cognitive, and social human world to these collections of functions exposed by a computer program.” Amy J. Ko, Washington university

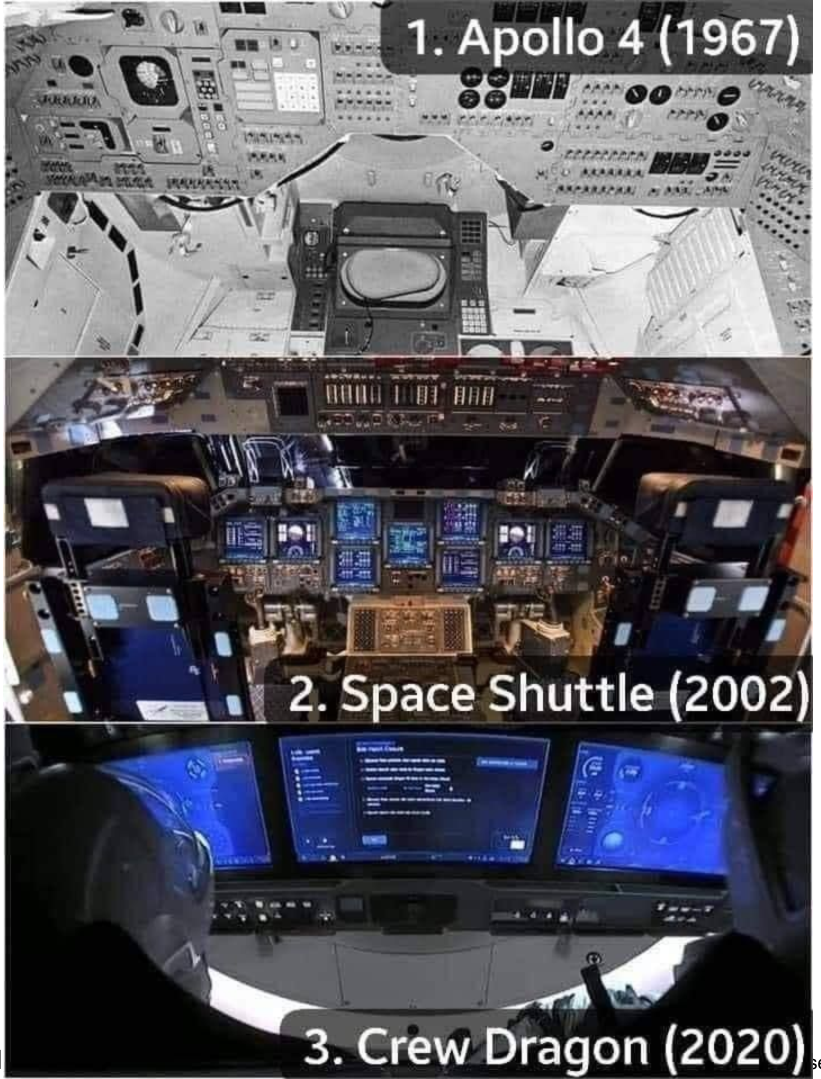
https://faculty.washington.edu/ajko/books/uist/theory.html#:~:text=User%20interfaces%20offer%20learnable%20representations,anything%20in%20the%20natural%20world.

Le interfacce utente

L'obiettivo primario dell'interazione fra uomo e macchina è quello di consentire all'utente di controllare e far funzionare la macchina in modo efficace.

L'interfaccia deve quindi essere progettata per semplificare l'interazione fra l'uomo e la macchina rendendo così l'esperienza d'uso piacevole e prolifica.

L'interazione fra uomo e macchina deve sempre essere facile, efficiente e divertente così da massimizzare la User Experience del prodotto.


1. Apollo 4 (1967)
2. Space Shuttle (2002)
3. Crew Dragon (2020)

Le interfacce utente

Un'interfaccia ben progettata consente all'utente di controllare l'apparato richiedendo uno sforzo fisico e cognitivo minimo.

La buona interfaccia massimizza inoltre la quantità di informazioni utili trasferite all'utente durante l'interazione evitando un sovraccarico informativo che provocherebbe nell'utente confusione e quindi frustrazione.

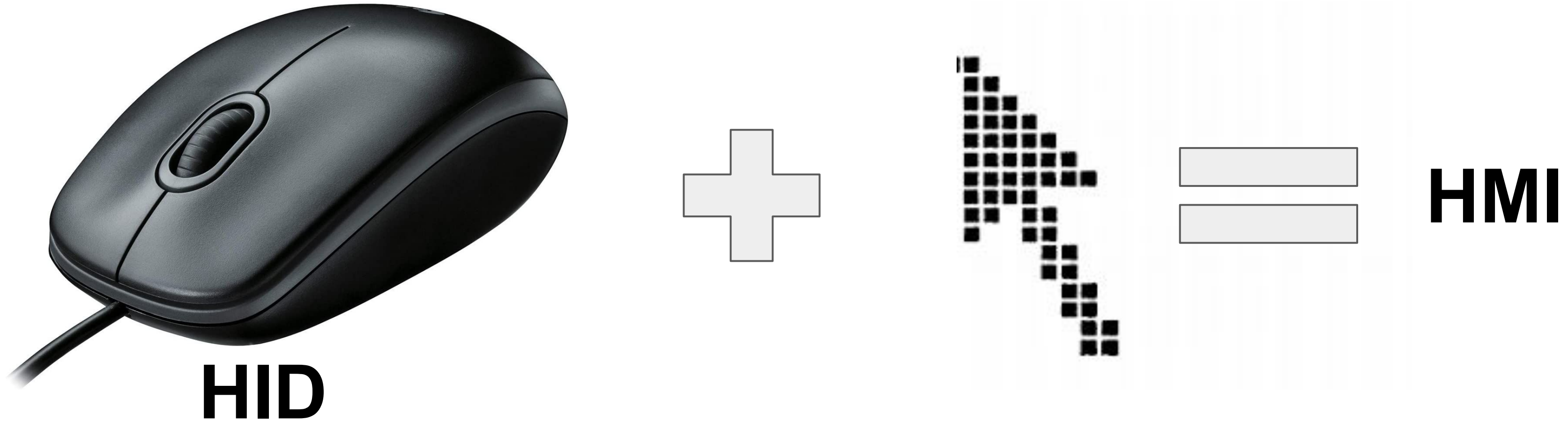
Le interfacce utente

Per questo motivo, la progettazione di un'interfaccia è per definizione un'attività interdisciplinare che va oltre la programmazione grafica e abbraccia la psicologia, le neuroscienze, il design e la fisica.

Le interfacce utente

User interfaces are composed of one or more layers including a human-machine interface (HMI) interfaces machines with physical input hardware such a keyboards, mice, game pads and output hardware such as computer monitors, speakers, and printers.

A device that implements a HMI is called a human interface device (HID).



Le interfacce utente

Le interfacce utente sono tipicamente organizzate sulla base dei sensi che utilizzano per stabilire l'interazione fra umano e macchina. Gli umani possiedono cinque sensi (Tatto, Vista, Udito, Olfatto e Gusto).

Questo porta ad identificare cinque categorie di interfacce possibili, più una sesta che è legata al cosiddetto senso dell'orientamento (balance in inglese) che però non è considerato un senso vero e proprio nella fisiologia umana.

Possiamo quindi organizzare le interfacce in 6 categorie:

- Tactile UI
- Visual UI
- Auditory UI
- Olfactory UI
- Gustatory UI
- Equilibrial UI

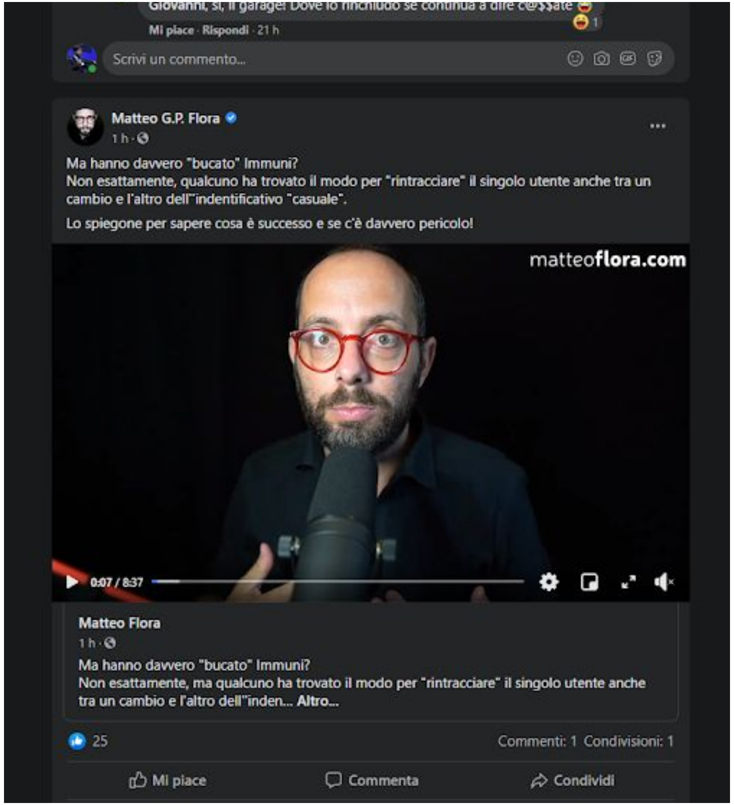
La maggior parte delle interfacce utente utilizza però più di un senso umano per stabilire il collegamento.

Le interfacce che usano più di un senso sono dette **CUI** o Composite User Interface.

Le più comuni e note CUI sono chiaramente le famose **GUI** o Graphical User Interface, le quali sono composte da interfacce grafiche (visual) e tattili (tactile).

Se ad una GUI andiamo ad aggiungere anche il suono otteniamo una **MUI** o Multimedia User Interface.

Estendere le interfacce con più canali (sensi) non è sempre una buona idea



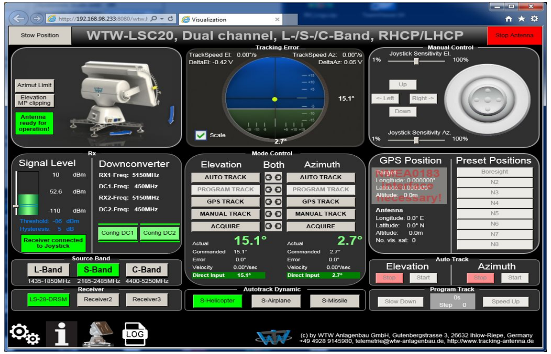
The user interface (UI)

There are three broad categories of CUI: **standard, virtual and augmented.**

Standard composite user interfaces use standard human interface devices like keyboards, mice, and computer monitors.

When the CUI blocks out the real world to create a **virtual reality**, the CUI is **virtual** and uses a virtual reality interface.

When the CUI does not block out the real world and creates **augmented reality**, the CUI is **augmented** and uses an augmented reality interface.



Standard

Virtual

Augmented

Le CUI possono essere anche classificate tramite il numero di sensi che utilizzano.

Ad esempio, lo **Smell-O-Vision** è una CUI standard 3S, cioè è un’interfaccia di tipo standard che nell'utilizzo coinvolge 3 sensi dell'utente (Visione, Udito e Olfatto).

Se si aggiungesse un quarto senso (per esempio le poltrone mobili dei cinema 4D) diventerebbe 4S.

Quando un'interfaccia utente interagisce con tutti i sensi umani viene chiamata **Qualia Interface**. il termine Qualia interface deriva dalla teoria filosofica dei Qualia (https://it.wikipedia.org/wiki/Qualia).

Il Microsoft Reactable è un interessante esempio di interfaccia aumentata 3S (MUI)

Human Interface Devices (HID)

DANIELE MAZZEI

Human Interface Devices

A human interface device or HID is a type of computer device usually used by humans.

HID takes input from humans and gives output to humans.

The term "HID" is used to indicate **the physical devices** and also the **USB-HID specification.**

The term was coined by Mike Van Flandern of Microsoft when he proposed that the USB committee create a Human Input Device class working group. The working group was renamed as the Human Interface Device class at the suggestion of Tom Schmidt of DEC because the proposed standard supported bi-directional communication.

HID software specification

HID (software specification)

The HID standard was adopted primarily to enable innovation in PC input devices and to **simplify the process of installing** such devices.

Prior to the introduction of the HID concept, devices usually conformed to strictly defined protocols for mouse, keyboards and joysticks; for example, the standard mouse protocol at the time supported relative X- and Y-axis data and binary input for up to two buttons, with no legacy support.

All hardware innovations necessitated either overloading the use of data in an existing protocol or the creation of custom device drivers and the evangelization of a new protocol to developers. By contrast, all **HID-defined devices deliver self-describing packages that may contain any number of data types and formats.**

HID (software specification)

A single HID driver on a computer parses data and enables **dynamic association of data I/O with application functionality**, which has enabled rapid innovation and development, and prolific diversification of new human-interface devices.

The HID protocol has its limitations, but all modern mainstream operating systems will recognize standard USB HID devices, such as keyboards and mice, without needing a specialized driver. When installed, a message saying that "A 'HID-compliant device' has been recognized" generally appears on screen.

In comparison, this message does not usually appear for devices connected via the PS/2 6-pin DIN connectors which preceded USB. the PS/2 standard does not support the HID protocol.

The USB human interface device class describes a USB HID.

HID (software specification)

In the HID protocol, there are 2 entities: the **"host"** and the **"device"**.

The device is the entity that directly interacts with a human, such as a keyboard or mouse.

The host communicates with the device and receives input data from the device on actions performed by the human. Output data flows from the host to the device and then to the human.

HID (software specification)

The HID protocol makes **implementation of devices very simple.**

Devices define their data packets and then present a "HID descriptor" to the host.

The HID descriptor is a hard coded array of bytes that describes the device's data packets.

This includes:

- how many packets the device supports,
- the size of the packets,
- the purpose of each byte and bit in the packet.

For example, a keyboard with a calculator program button can tell the host that the button's pressed/released state is stored as the 2nd bit in the 6th byte in data packet number 4

HID (software specification)

The device typically stores the HID descriptor in ROM and **does not need to intrinsically understand or parse the HID descriptor.** Some mouse and keyboard hardware in the market today is implemented using only an 8-bit CPU.

The host is expected to be a more complex entity than the device. **The host needs to retrieve the HID descriptor from the device and parse it before it can fully communicate with the device.**

Parsing the HID descriptor can be complicated. Multiple operating systems are known to have shipped bugs in the device drivers responsible for parsing the HID descriptors years after the device drivers were originally released to the public.

However, this complexity is the reason why rapid innovation with HID devices is possible.

HID (software specification)

The above mechanism describes what is known as **HID "report protocol"**.

Because it was understood that not all hosts would be capable of parsing HID descriptors, HID also defines "boot protocol". In boot protocol, only specific devices are supported with only specific features because fixed data packet formats are used.

The HID descriptor is not used in this mode so innovation is limited.

However, the benefit is that minimal functionality is still possible on hosts that otherwise would be unable to support HID.

The only devices supported in boot protocol are: Keyboard and Mouse

https://makeymakey.com/

Other protocols using HID

Since HID's original definition over USB, HID is now also used in other computer communication buses.

This enables HID devices that traditionally were only found on USB to also be used on alternative buses. This is done since existing support for USB HID devices can typically be adapted much faster than having to invent an entirely new protocol to support mouse, keyboards, and the like.

Known buses that use HID are:

- Bluetooth HID – Used for mouse and keyboards that are connected via Bluetooth
- Serial HID – Used in Microsoft's Windows Media Center PC remote control receivers.
- ZigBee input device – ZigBee (RF4CE) supports HID devices through the ZigBee input device profile.
- HID over I²C – Used for embedded devices in Microsoft Windows 8[2]
- HOGP (HID over GATT) – Used for HID devices connected using Bluetooth low energy technology

HID Devices

HID (peripheral)

HID peripherals can be organized in two main categories:

- Input devices
- Output devices

Input devices are based on **sensors** (a device, module, or subsystem whose purpose is to detect events or changes in the physical world its environment and convert it in analog or digital electronic information)

Output devices are based on **actuators** (a device, module, or subsystem whose purpose is to convert analog or digital electronic signals in physical events aimed at changing the physical)

HID classification (old fashion)

Input or Output HID are typically divided in classes according to the type of input/output used by the HID:

- Texts and chars
- Positions
- Sound
- Images
- Environmental parameters
- Position
- Health/bio/physiological parameters

Nowadays most of the novel HIDs use mixed technology so it is difficult to still classify them on the basis of what they sense...

Input Devices

Keyboards

The most used text and chars HID is the keyboard

Different types of keyboards are available and each is designed with a focus on specific features that suit particular needs. Today, most full-size keyboards use one of three different mechanical layouts, usually referred to as simply ISO (ISO/IEC 9995-2) ANSI standard.

ANSI standard alphanumeric keyboards have keys that are on three-quarter inch centers (0.75 inches (19 mm)), and have a key travel of at least 0.15 inches (3.8 mm).

Modern keyboard models contain a set number of total keys according to their given standard, described as 101, 104, 105, etc. and sold as "Full-size" keyboards.

Keyboard layouts

A keyboard layout is any specific physical, visual or functional arrangement of the keys, legends, or key-meaning associations (respectively) of a computer keyboard, mobile phone, or other computer-controlled typographic keyboard.

Physical layout is the actual positioning of keys on a keyboard.

Visual layout the arrangement of the legends (labels, markings, engravings) that appear on those keys.

Functional layout is the arrangement of the key-meaning association or keyboard mapping, determined in software, of all the keys of a keyboard: this (rather than the legends) determines the actual response to a key press.


Esc F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 PrtScr Insert Delete
~ ` ! 1 @ 2 # 3 $ 4 % 5 ^ 6 & 7 * 8 (9) 0 _ - + = Backspace
Tab Q W E R T Y U I O P { [}] | \
Caps Lock A S D F G H J K L : ; " ' Enter
Shift Z X C V B N M < , > . ? / Shift
Ctrl Fn Alt Alt Ctrl Page Up Page Down Home End

Keyboard layouts

Modern computer keyboards are designed to send a scancode to the operating system (OS) when a key is pressed or released: t**his code reports only the key's row and column**, not the specific character engraved on that key.

The OS converts the scancode into a specific binary character code using a "scancode to character" conversion table, called the keyboard mapping table.

This means that a physical keyboard may be dynamically mapped to any layout without switching hardware components – merely by changing the software that interprets the keystrokes.


esc
Help
F1
F2
F3
F4
Capture
F5
Batch Capture
F6
F7
F8
F9
F10
F11
F12
Camera 1
Project
Camera 2
Source Monitor
Camera 3
Timelines
Camera 4
Program Monitor
Camera 5
Effect Controls
Camera 6
Audio Track Mixer
Camera 7
Effects
Camera 8
Media Browser
Camera 9
Audio Clip Mixer
Record On /Off Toggle
Zoom Out
Zoom In
Clear Selection
Ripple Delete
delete
Next Column Field
tab
Previous Column Field
Ripple Trim Previous Edit
Quit
Ripple Trim Next Edit
Close
Extend Selected Edit
Edit Original
Rate Stretch Tool
Speed/ Duration...
Trim Edit
Trim Type
Title...
Slip Tool
Slide Tool
Make Subclip
Mark In
Go to In
Import...
Mark Out
Go to Out
Open
Pen Tool
Set Poster Frame
Thumbnail Size Previous
Send Backward
Thumbnail Size Next
Bring Forward
Zoom to Sequence
Toggle View
caps lock
Track Select
Select All
Snap
Save
Select Clip
Apply Video Transition
Match Frame
Find...
Audio Gain
Ungroup
Group
Hand Tool
Hide
Shuttle Left
Shuttle Stop
Add Edit
Shuttle Right
Lift
Extract
Render Effects In&Out
enter
return
shift
Zoom Tool
Undo
Mark Clip
Clear In&Out
Cut
Razor Tool
Copy
Selection Tool
Paste
Ripple Edit Tool
New Bin
Rolling Edit Tool
New Sequence
Add Marker
Next Marker
Insert
Prev Panel
Overwrite
Next Panel
Mark Selection
Bin
shift
fn
control
alt
option
command
Play / Stop
Pr
Made for Adobe Premiere Pro®
XSKN
command
alt
option
Step Back
Clip Start
Media Start
Prev Edit
Next Edit
Step Forward
Clip End
Media End

QWERTY Layout

The QWERTY layout far the most widespread layout in use, and the only one that is not confined to a particular geographical area.

QWERTY is a keyboard layout design for Latin-script alphabets.

The name comes from the order of the first six keys on the top left letter row of the keyboard (Q W E R T Y)

Multifunctional keyboards

Provide additional function beyond the standard keyboard.

Many are programmable, configurable computer keyboards and some control multiple PCs, workstations and other information sources, usually in multi-screen work environments.

Users have additional key functions as well as the standard functions and can typically use a single keyboard and mouse to access multiple sources.

Multifunctional keyboards may feature customised keypads, fully programmable function or soft keys for macros/pre-sets, biometric or smart card readers, trackballs, etc.

New generation multifunctional keyboards feature a touchscreen display to stream video, control audio visual media etc.

Common environments for multifunctional keyboards are complex, high-performance workplaces for financial traders and control room operators (emergency services, security, air traffic management; industry, utilities management, etc.).

Barcode readers

A barcode reader (or barcode scanner) is an optical scanner **that can read printed barcodes**, decode the data contained in the barcode and send the data to a computer.

Like a flatbed scanner, it consists of a light source, a lens and a light sensor translating for optical impulses into electrical signals.

Additionally, nearly all barcode readers contain decoder circuitry that can analyze the barcode's image data provided by the sensor and sending the barcode's content to the scanner's output port.

Barcode Readers

A barcode is a method of representing data in a visual, machine-readable form. Standard, barcodes represent data by varying the widths and spacings of parallel lines. A barcode encodes a string (typically numbers)

A QR is a bidimensional barcode. It uses four standardized encoding modes (numeric, alphanumeric, byte/binary, and kanji) to store data efficiently;

RFID

An RFID tag consists of a tiny radio transponder; a radio receiver and transmitter.

When triggered by an electromagnetic interrogation pulse from a nearby RFID reader device, the tag transmits digital data, usually an identifying inventory number, back to the reader. This number can be used to inventory goods.

There are two types:

- Passive tags are powered by energy from the RFID reader's interrogating radio waves.
- Active tags are powered by a battery and thus can be read at a greater range from the RFID reader; up to hundreds of meters.

Unlike a barcode, the tag doesn't need to be within the line of sight of the reader, so it may be embedded in the tracked object.

NFC

Near-Field-Communication (NFC) is a set of communication protocols for bidirectional communication between two electronic devices over a distance of 4 cm (11⁄2 in) or less.

NFC offers a low-speed connection with simple setup that can be used to bootstrap more-capable wireless connections.

Is it a HID or a communication technology?

Pointing Devices

A pointing device is an input interface that allows a user **to input spatial** (i.e., continuous and multi-dimensional) **data to a computer.**

CAD systems and graphical user interfaces (GUI) allow the user to control and provide data to the computer using physical gestures by moving a hand-held mouse or similar device across the surface of the physical desktop and activating switches on the mouse.

Movements of the pointing device are echoed on the screen by movements of the pointer (or cursor) and other visual changes.

Common gestures are point and click and drag and drop.

Pointing Devices

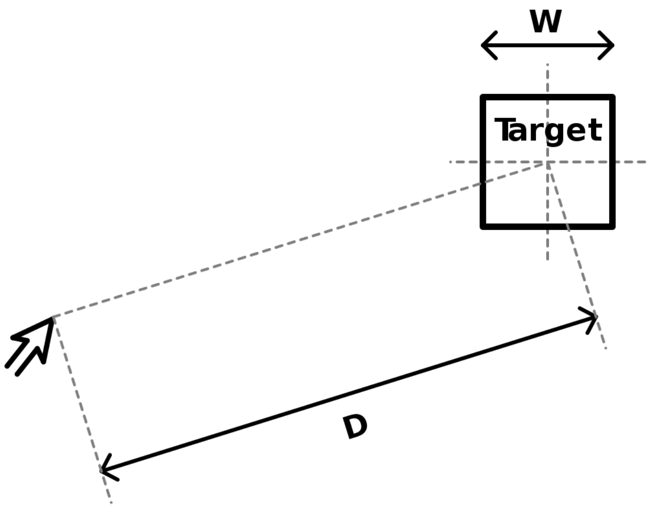
While the most common pointing device by far is the mouse, many more devices have been developed. However, the term "mouse" is commonly used as a metaphor for devices that move the cursor.

Fitts's law

Fitts's law is a predictive model of human movement primarily used in human–computer interaction and ergonomics.

This scientific law predicts that **the time required to rapidly move to a target area is a function of the ratio between the distance (D) to the target and the width of the target (W).**

Fitts's law is used to model the act of pointing, either by physically touching an object with a hand or finger, or virtually, by pointing to an object on a computer monitor using a pointing device.



Fitts's law

Movement Time:

- a = time to start/stop in seconds (empirically measured per device)
- b = inherent speed of the device (empirically measured per device)
- D is the distance from the starting point to the center of the target.
- W is the width of the target measured along the axis of motion.

$$\mathrm{MT} = a + b \cdot \mathrm{ID} = a + b \cdot \log_2\left(\frac{2D}{W}\right)$$

Notice that because the ID term depends only on the ratio of distance to width, the model implies that a target distance and width combination can be re-scaled arbitrarily without affecting movement time, which is impossible. Despite its flaws, this form of the model does possess remarkable predictive power across a range of computer interface modalities and motor tasks, and has provided many insights into user interface design principles.

Fitts's law

Proven to provide good timings for most age groups

Newer versions taken into account

- Direction (we are faster horizontally than vertically)
- Device weight
- Target shape
- Arm position (resting or midair)
- 2D and 3D (Zhai '96)
- Zero gravity environment

Pointing Devices classification

direct vs. indirect input

In case of a direct-input pointing device, **the on-screen pointer is at the same physical position as the pointing device** (e.g., finger on a touch screen, stylus on a tablet computer).

An indirect-input pointing device **is not at the same physical position as the pointer** but translates its movement onto the screen (e.g., computer mouse, joystick, stylus on a graphics tablet).

Pointing Devices classification

absolute vs. relative movement

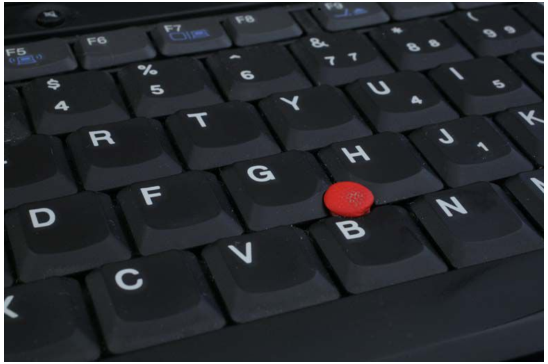
An absolute-movement input device (e.g., stylus, finger on touch screen) provides a consistent mapping between a point in the input space (location/state of the input device) and a point in the output space (position of pointer on screen).

A relative-movement input device (e.g., mouse, joystick) maps displacement in the input space to displacement in the output state. It therefore controls the relative position of the cursor compared to its initial position.

Pointing Devices classification

isotonic vs. elastic vs. isometric

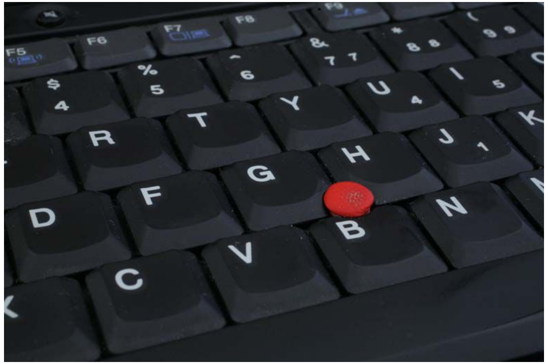
An isotonic pointing device **is movable and measures its displacement** (mouse, pen, human arm) whereas an isometric device **is fixed and measures the force which acts on it** (trackpoint, force-sensing touch screen). **An elastic device increases its force resistance with displacement** (joystick).



Pointing Devices classification

position control vs. rate control

A position-control input device (e.g., mouse, finger on touch screen) **directly changes the absolute or relative position of the on-screen pointer.** A rate-control input device (e.g., trackpoint, joystick) **changes the speed and direction of the movement of the on-screen pointer.**



What we know

- Direct pointing is Faster but less accurate than indirect (Haller ’84)
- Lots of studies confirm mouse is best for most tasks for speed and accuracy: Trackpoint < Trackballs & Touchpads < Mouse
- For short distances cursor keys are better than pointing devices
- Disabled prefer joysticks and trackballs:
  - If force application is a problem, then touch sensitive is preferred
  - Vision impaired have problems with most pointing devices
- Use multimodal approach or customizable cursors improve usability and performances
- Keep in mind Fits’ law:
  - Large targets reduce time and frustration;
  - Designers should smooth out and reduce trajectories

The father of all pointing devices

A computer mouse is a hand-held pointing device that detects two-dimensional motion relative to a surface.

This motion is typically translated into the motion of a pointer on a display, which allows a smooth control of the graphical user interface of a computer.

The mouse evolution

In 2000, Logitech introduced a "tactile mouse" that contained a small actuator to make the mouse vibrate. Such a mouse can augment user-interfaces with haptic feedback (output), such as giving feedback when crossing a window boundary.

Other modern pointing devices have extended the input dimensions up to 6 DOF

Novel Pointing Devices

Eye Tracking

Eye tracking is the process of measuring either the point of gaze (where one is looking) or the motion of an eye relative to the head.

An eye tracker is a device for measuring eye positions and eye movement.

Eye trackers are used in research on the visual system, in psychology, in psycholinguistics, marketing, as an input device for human-computer interaction, and in product design.

Eye trackers are also being increasingly used for rehabilitative and assistive applications (related for instance to control of wheel chairs, robotic arms and prostheses).

There are a number of methods for measuring eye movement. The most popular variant uses video images from which the eye position is extracted.

Eye Tracking

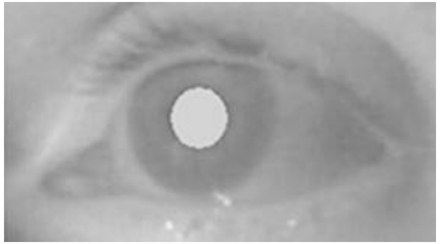
Light, typically infrared, is reflected from the eye and sensed by a video camera or some other specially designed optical sensor.

The information is then analyzed to extract eye rotation from changes in reflections.

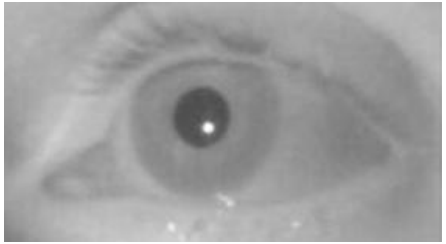
Video-based eye trackers typically use the corneal reflection and the center of the pupil as features to track over time.

Eye tracking methods

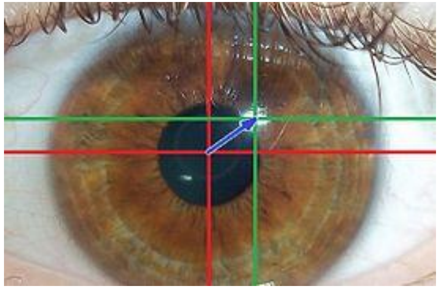
The most widely used current designs are **video-based eye-trackers.**



A camera focuses on one or both eyes and records eye movement. Most modern eye-trackers use the center of the pupil and infrared/near-infrared non-collimated light to create corneal reflections (CR).



The vector between the pupil center and the corneal reflections can be used to compute the point of regard on surface or the gaze direction. A simple calibration procedure of the individual is usually needed before using the eye tracker.



Two general types of infrared/near-infrared (also known as active light) eye-tracking techniques are used: **bright-pupil (top) and dark-pupil (center).** Their difference is based on the location of the illumination source with respect to the optics.

Another, less used, method is known as **passive light (bottom)**. It uses visible light to illuminate

Eye tracking methods

If the illumination is coaxial with the optical path, then the eye acts as a retroreflector as the light reflects off the retina creating a bright pupil effect similar to red eye. If the illumination source is offset from the optical path, then the pupil appears dark because the retroreflection from the retina is directed away from the camera.

Bright-pupil tracking creates greater iris/pupil contrast, allowing more robust eye-tracking with all iris pigmentation, and greatly reduces interference caused by eyelashes and other obscuring features. It also allows tracking in lighting conditions ranging from total darkness to very bright.

Bright-pupil tracking is more reliable but require more complex hardware setup

Eye-tracking vs. gaze-tracking

Eye-trackers necessarily measure the rotation of the eye with respect to some frame of reference. This is usually tied to the measuring system. Thus, if the measuring system is head-mounted, as with video-based system mounted to a helmet, then eye-in-head angles are measured.

To deduce the line of sight in world coordinates, the head must be kept in a constant position or its movements must be tracked as well. In these cases, head direction is added to eye-in-head direction to determine gaze direction.

If the measuring system is table-mounted, as with table-mounted camera ("remote") systems, then gaze angles are measured directly in world coordinates. Typically, in these situations head movements are prohibited.

Some results are available on human eye movements under natural conditions where head movements are allowed as well.

Eye Tracking mouse

https://www.youtube.com/watch?v=oSo8fbZfHLk&ab_channel=TobiiGaming

https://www.youtube.com/watch?v=4fvdBhPdhIU&ab_channel=TobiiPro

Data Glove

A wired glove (also called a "dataglove") is an input device for human–computer interaction worn like a glove.

Various sensor technologies are used to capture physical data such as bending of fingers.

Often a motion tracker, such as a magnetic tracking device or inertial tracking device, is attached to capture the global position/rotation data of the glove.

These movements are then interpreted by the software that accompanies the glove, so any one movement can mean any number of things.

Gestures can then be categorized into useful information, such as to recognize sign language or other symbolic functions.

Haptic Devices

Haptic devices (or haptic interfaces) are mechanical devices that mediate communication between the user and the computer. **Haptic devices allow users to touch, feel and manipulate three-dimensional objects in virtual environments and tele-operated systems.**

Most common computer interface devices, such as basic mice and joysticks, are input only devices, meaning that they track a user's physical manipulations but provide no manual feedback. As a result, information flows in only one direction, from the peripheral to the computer.

Haptic devices are input-output devices, meaning that they track a user's physical manipulations (input) and provide realistic touch sensations coordinated with on-screen events (output).

Haptic Devices

Smart Paper, Whiteboards and similars

A novel generation of devices aimed at digitizing user interaction with paper and whiteboard have been developed in the last years.

These devices digitize the user writing by means of tracked smart pens and/or sensorized surfaces

This is a cross categories interface where pointing and images are used as blended inputs

Speech and Auditory Input Interfaces

Audio and sound acquisition

In physics, sound is a vibration that propagates as an acoustic wave, through a transmission medium such as a gas, liquid or solid.

In human physiology and psychology, sound is the reception of such waves and their perception by the brain.

Only acoustic waves that have frequencies lying between about 20 Hz and 20 kHz, the audio frequency range, elicit an auditory percept in humans.

In air at atmospheric pressure, these represent sound waves with wavelengths of 17 meters to 1.7 centimetres.

Sound waves above 20 kHz are known as ultrasound and are not audible to humans. Sound waves below 20 Hz are known as infrasound. Different animal species have varying hearing ranges.

Audio and sound acquisition

Sound can be acquired using microphones.

A microphone is a device – a sensor– that converts sound into an electrical signal.

Microphones are widely used as HID

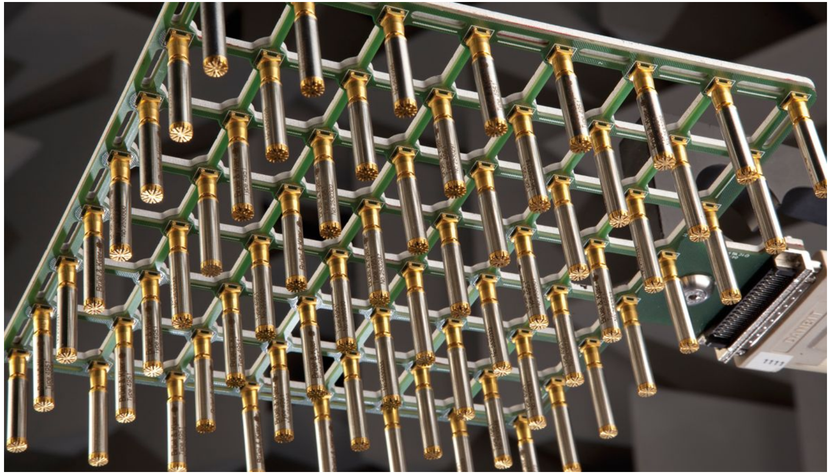
Several types of microphone are used today, which employ different methods to convert the air pressure variations of a sound wave to an electrical signal.

Microphone arrays

A microphone array is any number of microphones operating in tandem.

The are used for:

- Systems for extracting voice input from ambient noise (notably telephones, speech recognition systems, hearing aids)
- Surround sound and related technologies
- Binaural recording
- Locating objects by sound: acoustic source localization
- High fidelity original recordings
- Environmental Noise Monitoring



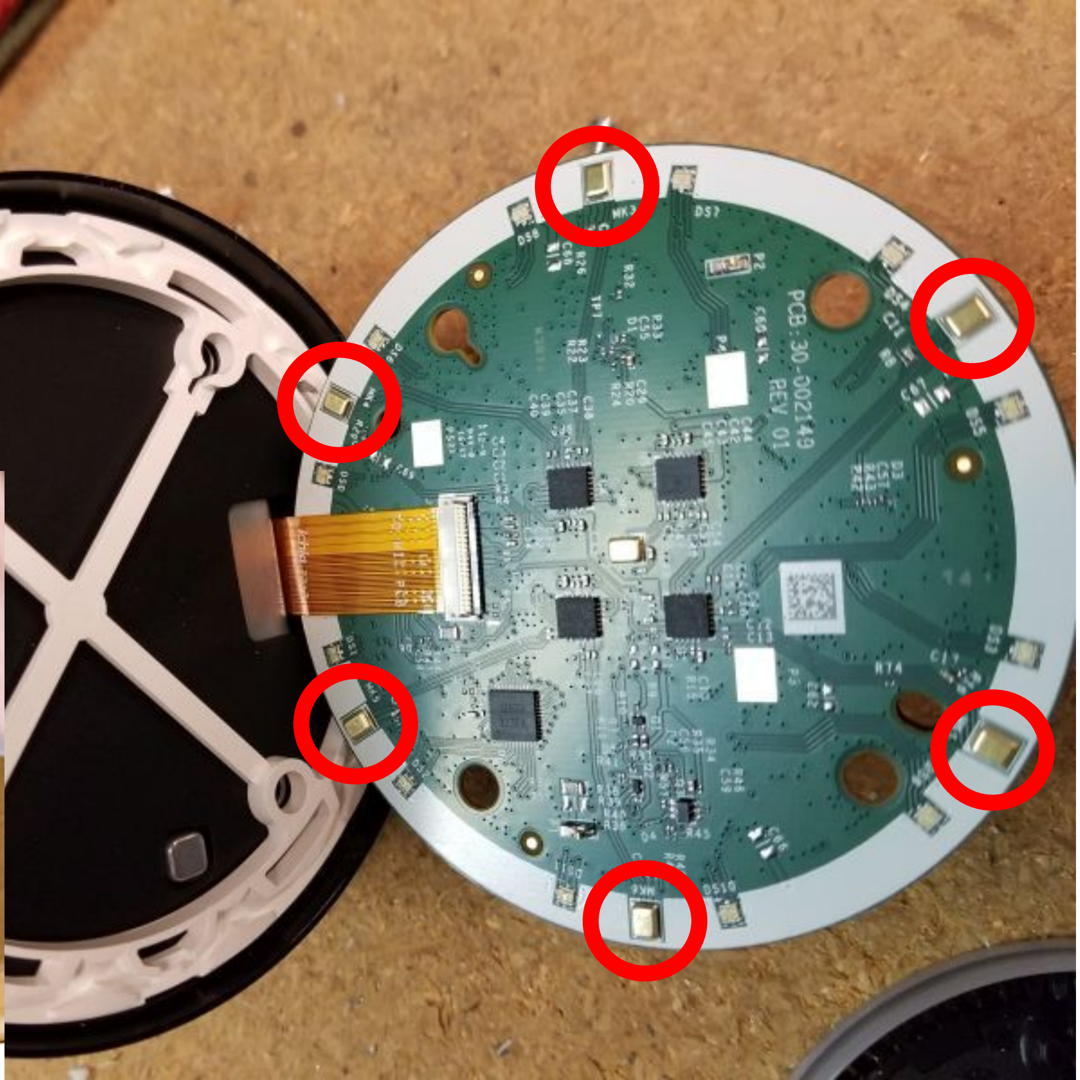
Microphone Arrays

Typically, an array is made up of omnidirectional microphones, directional microphones, or a mix of omnidirectional and directional microphones distributed about the perimeter of a space

All microphones are linked to a computer that records and interprets the results into a coherent form.

Arrays may also be formed using numbers of very closely spaced microphones.

Given a fixed physical relationship in space between the different individual microphone transducer array elements, simultaneous DSP (digital signal processor) processing of the signals from each of the individual microphone array elements **can create one or more "virtual" microphones.**


PCB:30-002149
REV 01


echo dot
Add Alexa to any room

Speech and Auditory Interfaces

There's the dream…. Then there's reality

Practical apps don't really allows freeform discussions with a computer :(

Main Design Goals:

- Low cognitive load
- Low error rates
- Natural user experience

Speech and Auditory Interfaces

Problem and limitations:

- Bandwidth is much lower than visual displays
- Ephemeral nature of speech (tone, etc.)
- Difficulty in parsing/searching → higher computational load

https://www.youtube.com/watch?v=IKZToY-V16w&ab_channel=EliyahuShatz

Speech and Auditory Interfaces

Succeed With:

Specialized vocabularies (like medical or legal)

- Dictate reports, notes, letters
- Communication skills practice (virtual patient)
- Automatic retrieval/transcription of audio content (like radio, CC)
- Security/user ID

https://www.youtube.com/watch?v=ZLpuYQ401s8&ab_channel=JonWahrenberger

Image based Input User Interfaces

Image Sensors

An image sensor is a sensor that detects and conveys information used to make an image.

It does so by converting the variable attenuation of light waves (as they pass through or reflect off objects) into signals, small bursts of current that convey the information.

The waves can be light or other electromagnetic radiation.

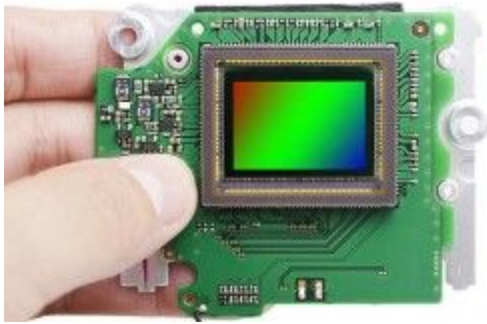
Image sensors are used in electronic imaging devices of both analog and digital types, which include digital cameras, camera modules, camera phones, optical mouse devices, medical imaging equipment, night vision equipment such as thermal imaging devices, and others.

Image Sensors

The two main types of electronic image sensors are the charge-coupled device (CCD) and the active-pixel sensor (CMOS sensor).

Both CCD and CMOS sensors are based on metal–oxide–semiconductor (MOS) technology, with CCDs based on MOS capacitors and CMOS sensors based on MOSFET (MOS field-effect transistor) amplifiers.

Analog sensors for invisible radiation tend to involve vacuum tubes of various kinds.



3D image capture device

3D scanning is the process of analyzing a real-world object or environment to collect data on its shape and possibly its appearance (e.g. colour).

The collected data can then be used to construct digital 3D models. 3D data is useful for a wide variety of applications.

These devices are used extensively by the entertainment industry in the production of movies and video games, including virtual reality.

Other common applications of this technology include **augmented reality,motion capture, gesture recognition**, robotic mapping, industrial design, orthotics and prosthetics,reverse engineering and prototyping, quality control/inspection and the digitization of cultural artifacts.

3D image capture device

A 3D scanner can be based on many different technologies, each with its own limitations, advantages and costs.

Many limitations in the kind of objects that can be digitised are still present. For example, **optical technology may encounter many difficulties with shiny, reflective or transparent objects.**

3D scanning technologies can be divided in two main categories: **Passive and Active**

Types of 3D scanners

Passive scanning: Passive 3D imaging solutions do not emit any kind of radiation themselves, but instead rely on detecting reflected ambient radiation.

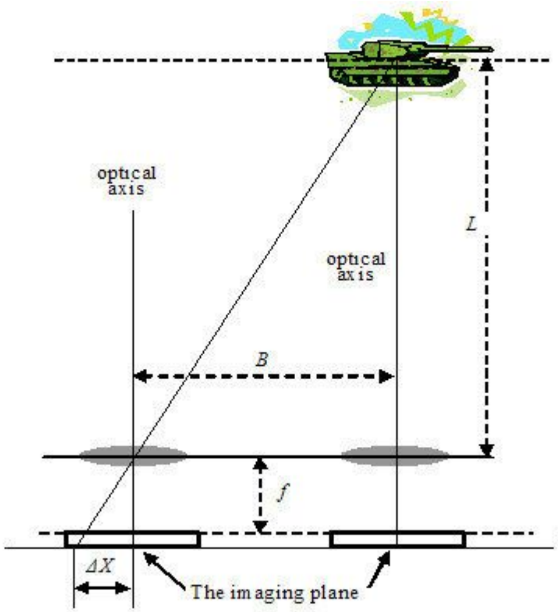
Most solutions of this type detect visible light because it is a readily available ambient radiation.

Other types of radiation, such as infrared could also be used. Passive methods can be very cheap, because in most cases they do not need particular hardware but simple digital cameras.

Stereoscopic cameras are the most common passive 3D scanning systems

3D passive scanning

Stereoscopic systems usually employ two video cameras, slightly apart, looking at the same scene. By analysing the slight differences between the images seen by each camera, it is possible to determine the distance at each point in the images. This method is based on the same principles driving human stereoscopic vision.

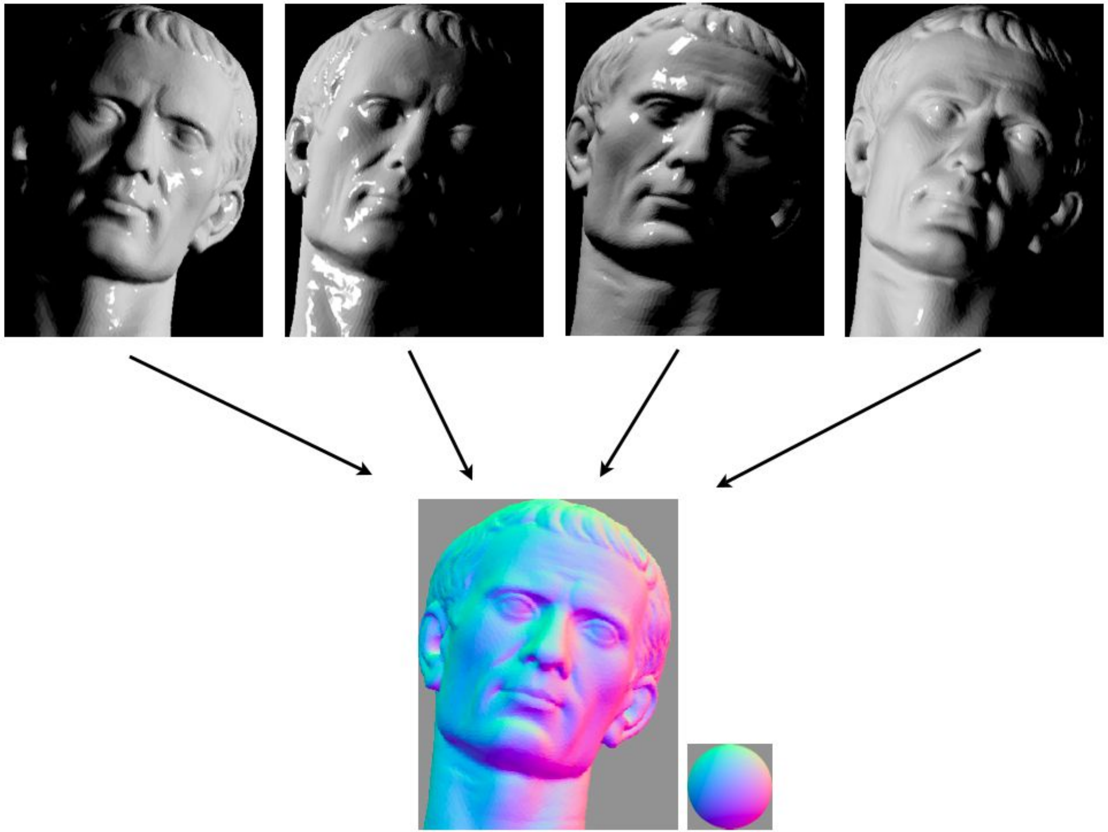


Based on the similarity of the triangles, the depth L is computed as a function of the sensor parameters (B and f) and the disparity ΔX (difference between the two images of the same physical point):

$$L = \frac{B\,f}{\Delta X}$$

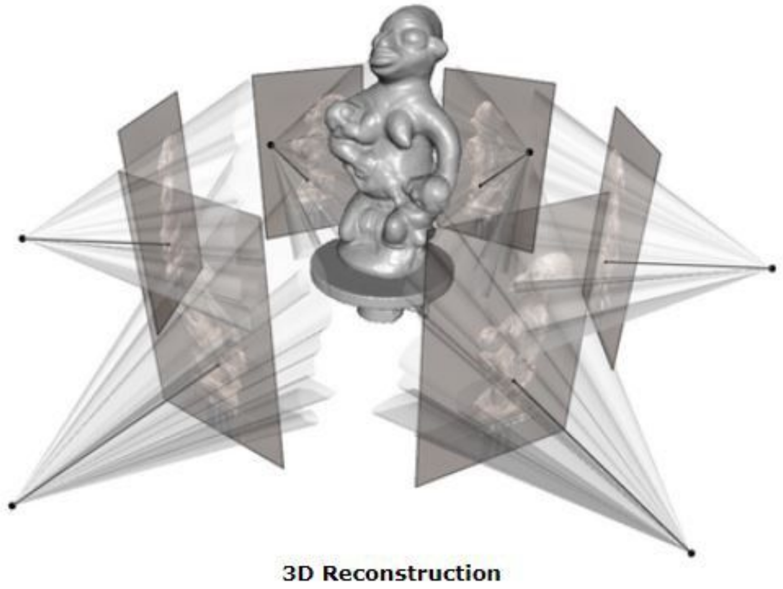
3D passive scanning

Photometric systems usually use a single camera, but take multiple images under varying lighting conditions. These techniques attempt to invert the image formation model in order to recover the surface orientation at each pixel.



3D passive scanning

Silhouette techniques use outlines created from a sequence of photographs around a three-dimensional object against a well contrasted background. These silhouettes are extruded and intersected to form the visual hull approximation of the object. With these approaches some concavities of an object (like the interior of a bowl) cannot be detected.



3D Active Scanning

Active scanners emit some kind of radiation or light and detect its reflection or radiation passing through object in order to probe an object or environment. Possible types of emissions used include light, ultrasound or x-ray.

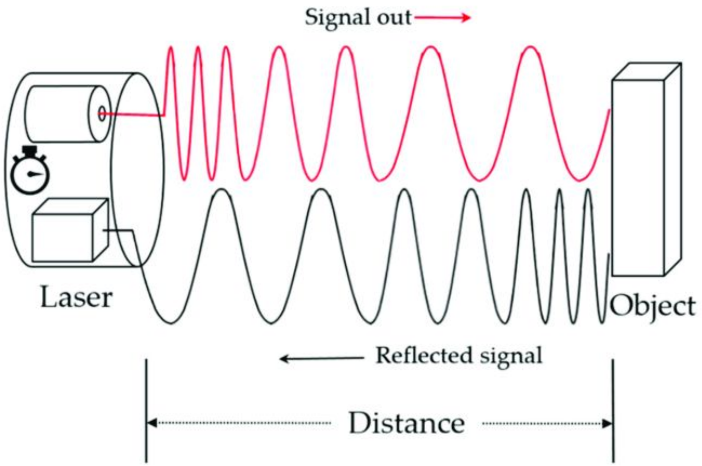
Various typologies: Time-of-flight, Triangulation, Structured light, Modulated Light

3D Active Scanning

The time-of-flight 3D laser scanner is an active scanner that uses laser light to probe the subject. At the heart of this type of scanner is a time-of-flight laser range finder.

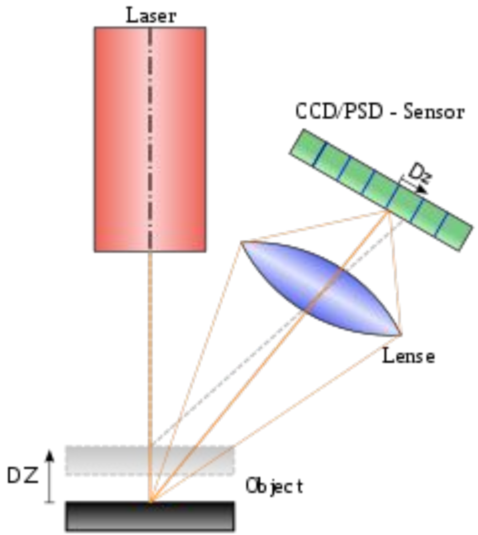
The laser range finder finds the distance of a surface by timing the round-trip time of a pulse of light. A laser is used to emit a pulse of light and the amount of time before the reflected light is seen by a detector is measured. 3.3 picoseconds (approx.) is the time taken for light to travel 1 millimetre.

The laser range finder only detects the distance of one point in its direction of view. Thus, the scanner scans its entire field of view one point at a time by changing the range finder's direction



3D Active Scanning

Triangulation based 3D laser scanners are also active scanners that use laser light to probe the environment. With respect to time-of-flight 3D laser scanner the triangulation laser shines a laser on the subject and exploits a camera to look for the location of the laser dot.



Depending on how far away the laser strikes a surface, the laser dot appears at different places in the camera's field of view.

This technique is called triangulation because the laser dot, the camera and the laser emitter form a triangle.

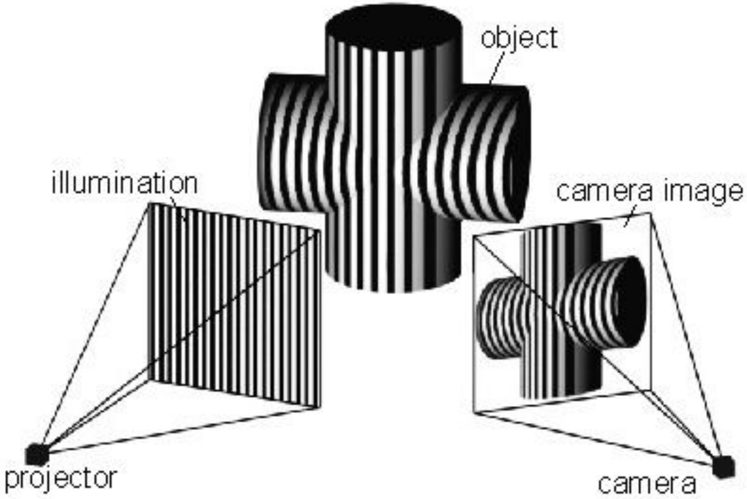
3D Active Scanning

Structured-light 3D scanners project a pattern of light on the subject and look at the deformation of the pattern on the subject. The pattern is projected onto the subject using either an LCD projector or other stable light source.

A camera, offset slightly from the pattern projector, looks at the shape of the pattern and calculates the distance of every point in the field of view.

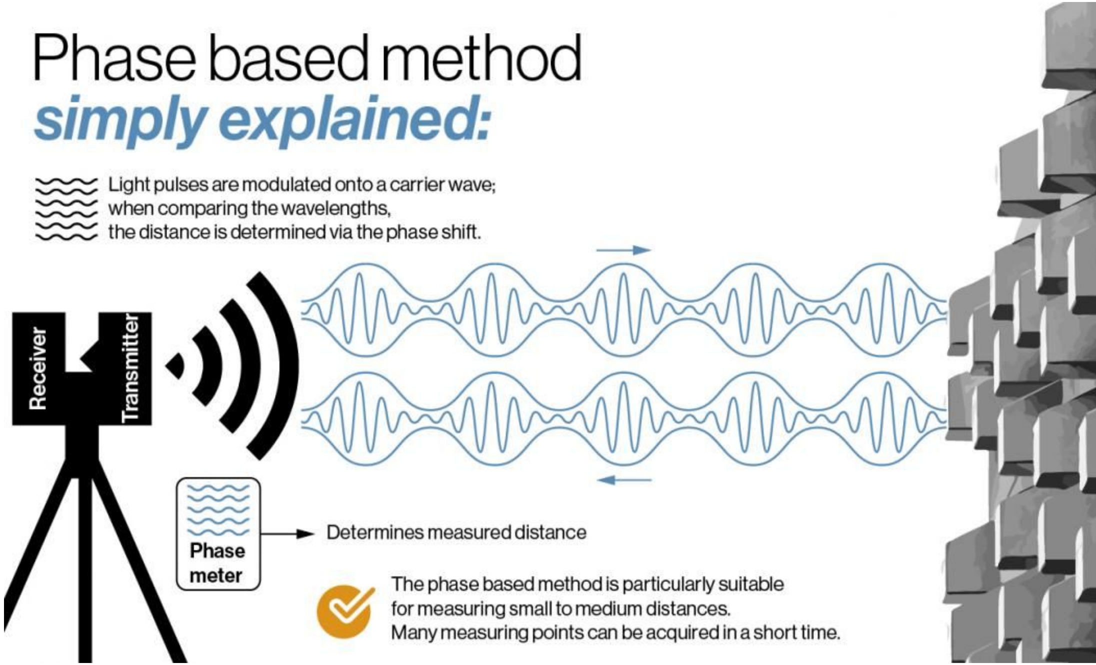
The advantage of structured-light 3D scanners is speed and precision. Instead of scanning one point at a time, structured light scanners scan multiple points or the entire field of view at once.

Scanning an entire field of view in a fraction of a second reduces or eliminates the problem of distortion from motion.



3D Active Scanning

Modulated light 3D scanners shine a continually changing light at the subject. Usually the light source simply cycles its amplitude in a sinusoidal pattern. A camera detects the reflected light and the amount the pattern is shifted by determines the distance the light travelled. Modulated light also allows the scanner to ignore light from sources other than a laser, so there is no interference.



Microsoft Kinect

Kinect is a line of motion sensing input devices produced by Microsoft and first released in 2010.

The technology includes a set of hardware originally developed by PrimeSense, incorporating RGB cameras, infrared projectors **(active - structured light)** and detectors that mapped depth through either structured light or time of flight calculations, and a microphone array, along with software and artificial intelligence from Microsoft to allow the device to perform real-time gesture recognition, speech recognition and body skeletal detection for up to four people, among other capabilities.

This enables Kinect to be used as a hands-free natural user interface device to interact with a computer system.

Product discontinued→ [alternatives]

SceneAnalyzer - V. 2.0
Screenshot

Novel UI are blended!

Wii Remote and similar Motion Sensing devices

The Wii Remote, is the primary game controller for Nintendo's Wii home video game console.

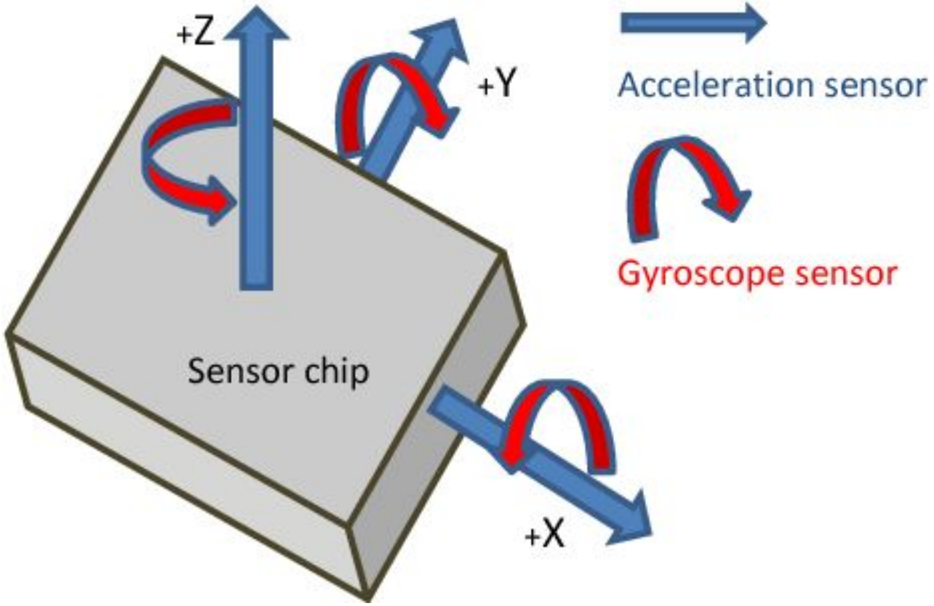
An essential capability of the Wii Remote is its motion sensing capability, which allows the user to interact with and manipulate items on screen via gesture recognition and pointing, using IMU and optical sensor technology.

The Wii Remote was eventually succeeded by the more advanced Joy-Con controllers of the Nintendo Switch.

IMU Inertial Measurement Unit

An inertial measurement unit (IMU) is an electronic device that measures and reports a body's **specific force, angular rate**, and sometimes the **orientation of the body**, using a combination **of accelerometers, gyroscopes, and sometimes magnetometers.**

9-Axis devices combine a **3-axis gyroscope, 3-axis accelerometer and 3-axis compass** (magnetometer) in the same chip together with an onboard Digital Motion Processor capable of processing the complex MotionFusion algorithms



Hacking the user interface and experience

https://www.youtube.com/watch?v=6YIAR4WZmes&ab_channel=DanieleMazzei

https://www.youtube.com/watch?v=6F7MzmySx9g&ab_channel=DanieleMazzei

https://www.youtube.com/watch?v=oQ2VCi-6uGI&ab_channel=DanieleMazzei

Wearable Devices and User Interfaces

A wearable computer is a computing device worn on the body. <u>The interface and the computing unit are merged together!</u>

Wearables may be for general use, in which case they are just a particularly small example of mobile computing. Alternatively they may be for **specialized purposes** such as fitness trackers.

They may incorporate special sensors such as accelerometers, thermometer and heart rate monitors, or novel user interfaces such as Google Glass, an optical head-mounted display controlled by gestures.

It may be that specialized wearables will evolve into general all-in-one devices, as happened with the convergence of PDAs and mobile phones into smartphones.

Wearable Devices and User Interfaces

Wearables are typically worn on the wrist (e.g. fitness trackers), hung from the neck (like a necklace), strapped to the arm or leg (smartphones when exercising), or on the head (as glasses or a helmet), though some have been located elsewhere (e.g. on a finger or in a shoe).

Devices carried in a pocket or bag – such as smartphones and before them pocket calculators and PDAs, may or may not be regarded as 'worn'.

Wearable computers have various technical issues common to other mobile computing, such as batteries, heat dissipation, software architectures, wireless and personal area networks, and data management.

Many wearable computers are active all the time, e.g. processing or recording data continuously.

Heart Rate Wearable Monitor

A heart rate monitor (HRM) is a personal monitoring device that allows one to measure/display heart rate in real time or record the heart rate for later study.

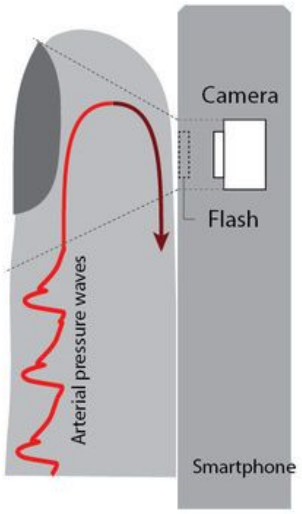
Consumer heart rate monitors are designed for everyday use and do not use wires to connect and are (typically) not suitable for medical applications

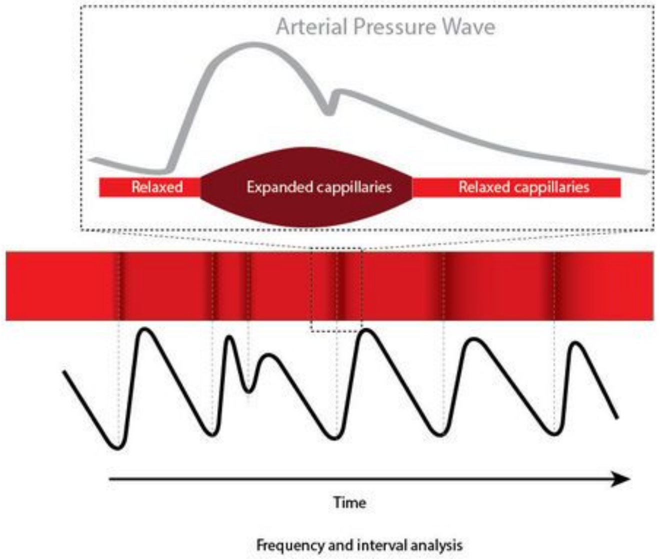
they commonly use electrical and/or optical measurement principles. Both types of signals can provide the same basic heart rate data, using fully automated algorithms to measure heart rate.

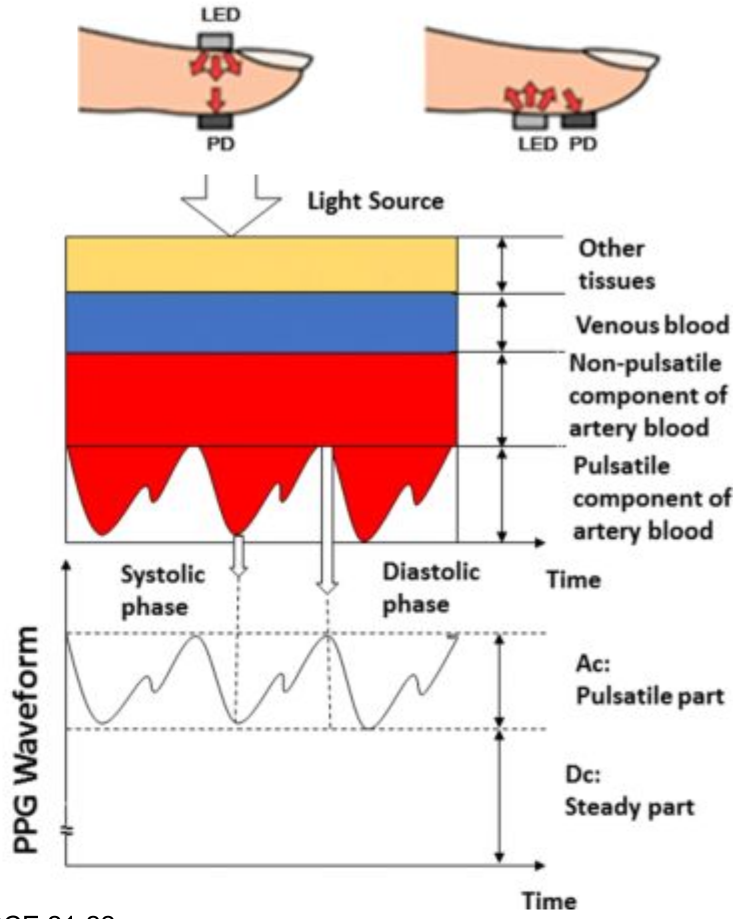
ECG (Electrocardiography) sensors measure the bio-potential generated by electrical signals that control the expansion and contraction of heart. VIDEO

PPG (Photoplethysmography) sensors use a light-based technology to measure the blood volume controlled by the heart's pumping action. some devices using this technology are able to measure aslo blood oxygen saturation (SpO2). more info

PPG (Photoplethysmography)







EEG Headset

Electroencephalography (EEG) is a monitoring method to record the electrical activity of the brain.

Wearable EEG headsets position noninvasive electrodes along the scalp. The clinical definition of EEG is the recording of brain activity over a period of time. EEG electrodes pick up on and record the electrical activity in your brain.

The collected signals are amplified and digitized then sent to a computer or mobile device for storage and data processing.

EEG Headset are used as pointing devices for dibale and impaired subjects

https://www.youtube.com/watch?v=LZrat-VG4Ms&ab_channel=GSMArenaOfficial

Natural User Interfaces

NUI Natural User Interfaces

“Until now, we have always had to adapt to the limits of technology and conform the way we work with computers to a set of arbitrary conventions and procedures. With NUI, computing devices will adapt to our needs and preferences for the first time and humans will begin to use technology in whatever way is most comfortable and natural for us.”

—Bill Gates, co-founder of the multinational technology company Microsoft

Defining NUIs is difficult, but often when we think about user interfaces that are natural and easy to use, we think of **user interfaces where the interaction is direct and consistent with our ‘natural’ behaviour.**

source: https://www.interaction-design.org/literature/article/natural-user-interfaces-what-are-they-and-how-do-you-design-user-interfaces-that-feel-natural

Natural User Interfaces

A natural user interface, or NUI, **is a user interface that is effectively invisible**, and remains invisible as the user continuously learns increasingly complex interactions.

The word natural is used because most computer interfaces use artificial control devices whose operation has to be learned. **An NUI relies on a user being able to quickly transition from novice to expert.**

While the interface requires learning, that learning is eased through design which **gives the user the feeling that they are instantly and continuously successful.**

Thus, **"natural" refers to a goal in the user experience** – that the interaction comes naturally, while interacting with the technology, rather than that the interface itself is natural.


CLI
• Codified
• Strict
GUI
• Metaphor
• Exploratory
NUI
• Direct
• Intuitive

Natural User Interfaces

NUI contrasted with the idea of an intuitive interface, referring to one that can be used without previous learning. Several design strategies have been proposed which have met this goal to varying degrees of success.

Natural User Interfaces

Some iPad gestures come naturally and intuitively—e.g., swiping with one finger to the left or right—which is all part of the ‘magic’ that took the iPad to such prominence.

When you swipe with one finger, you scroll through pages or you move content from one side of the screen to the other. The gesture itself corresponds to the action you are performing.

it shows the power of the principle here—things in the ‘digital world’ behave as they do in the ‘analogue world’.

Some gestures, though, require more learning—e.g., a four-finger swipe to the left or right. The four-finger swipe is not intuitive—it doesn’t come naturally to us. Swiping with four fingers requires you as a user to learn it as a dedicated movement, because you need an understanding of the underlying system

Natural User Interfaces

“Voice, gesture, touch does not necessarily Natural User Interface make.”

—Bill Buxton, Principal Researcher at Microsoft

Microsoft has done a lot of research into NUIs.

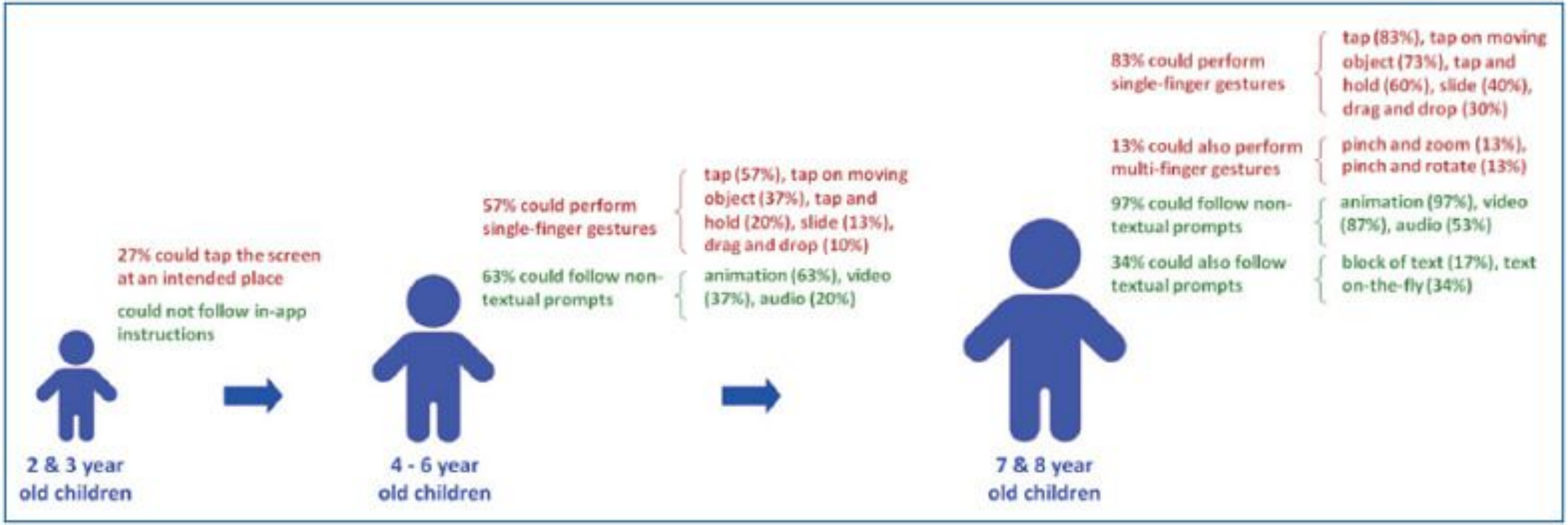
NUIs exploit skills that we have acquired through a lifetime of living in the world, which minimizes the cognitive load and therefore minimizes the distraction.

NUIs should always be designed with the use context in mind. No user interface can be natural in all use contexts and to all users.

While gestures, voice and touch are important components of many NUIs, they will only feel natural to a user if they match her skill level and her use context.

Natural means no learning

Two- and 3-year-old children could not follow any prompting technique and only a minority (27%) could tap the touchscreen at an intended place. Four- to 6-year-old children could perform simple gestures like a tap and slide (57%) and follow instructions provided through animation (63%). Seven- and 8-year-old children could perform more sophisticated gestures like dragging and dropping (30%) and follow instructions provided in audio and video formats (34%). source here



Joshua Blake lists four guidelines for designing NUIs

- Instant expertise
- Progressive learning
- Direct interaction
- Low cognitive load (primarily use innate abilities and simple skills)

more info here
https://www.interaction-design.org/literature/article/natural-user-interfaces-what-are-they-and-how-do-you-design-user-interfaces-that-feel-natural

NUI in a nutshell

An NUI is a user interface that feels natural to use because it fits the skills and context of the user.

- An NUI should take advantage of the users' existing skills and knowledge.
- An NUI should have a clear learning path and allow both novice and expert users to interact in a natural way.
- Interaction with an NUI should be direct and fit the user's context.
- Whenever possible, you should prioritize taking advantage of the user's basic skills.

great design is about satisfying needs, not outsmarting users.

Reality Based Interfaces

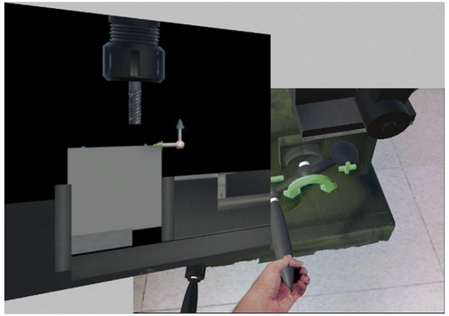
One strategy for the design of NUI is the use of a "reality user interface" ("RUI"), also known as "reality-based interfaces" (RBI) methods.

One example of an RUI strategy is to use a wearable device to render real-world objects "clickable", i.e. so that the wearer can click on any everyday object so as to make it function as a hyperlink, thus merging cyberspace and the real world.

Because the term "natural" is evocative of the "natural world", RBI are often confused for NUI, when in fact they are merely one means of achieving it.

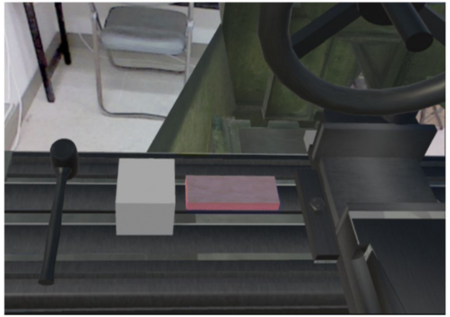
(a) Users' first-person view in HTC Vive

(b) Third-person view

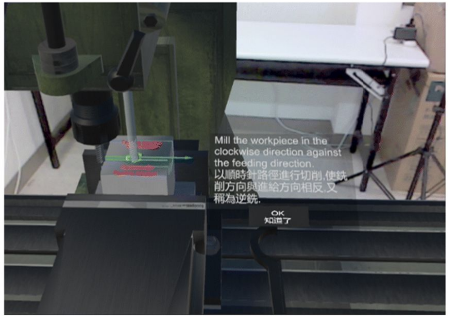


(c) Auxiliary view and augmented instruction

(d) Grasp a virtual object



(e) Highlight object



(f) 3D animation

https://www.youtube.com/watch?v=LZWnGo_IsDw&ab_channel=RUISVR

Natural User Interfaces without RBI

One example of a strategy for designing a NUI not based in RBI is the strict limiting of functionality and customization, so that users have very little to learn in the operation of a device.

Provided that the default capabilities match the user's goals, the interface is effortless to use.

This is an overarching design strategy in Apple's iOS.
https://www.youtube.com/watch?v=qhEt1Pd-twM&ab_channel=phototristan

Because this design is coincident with a direct-touch display, non-designers commonly misattribute the effortlessness of interacting with the device to that multi-touch display, and not to the design of the software where it actually resides.

CEEDs project

https://www.youtube.com/user/ceedsproject

GUI design

GUI Design

Graphical User Interface (GUI) Design focuses on anticipating what users might need to do and ensuring that the interface has elements that are easy to access, understand, and use to facilitate those actions.

UI brings together concepts from **interaction design, visual design, and information architecture.**

Interface structures

An organizational structure is how you define the relationships between pieces of content.

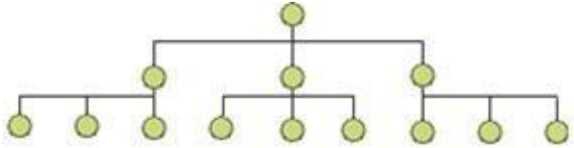
Successful structures allow users to predict where they will find information on the site.

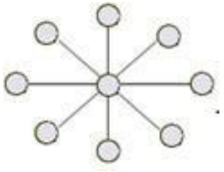
It's important to take into account user expectations and implement consistent methods of organizing and displaying information so that users can extend their knowledge from familiar pages to unfamiliar ones.

The four main organizational structures are **Hierarchical, Sequential, Matrix and database model.**

source: https://www.usability.gov/how-to-and-tools/methods/organization-structures.html

Hierarchical Structures

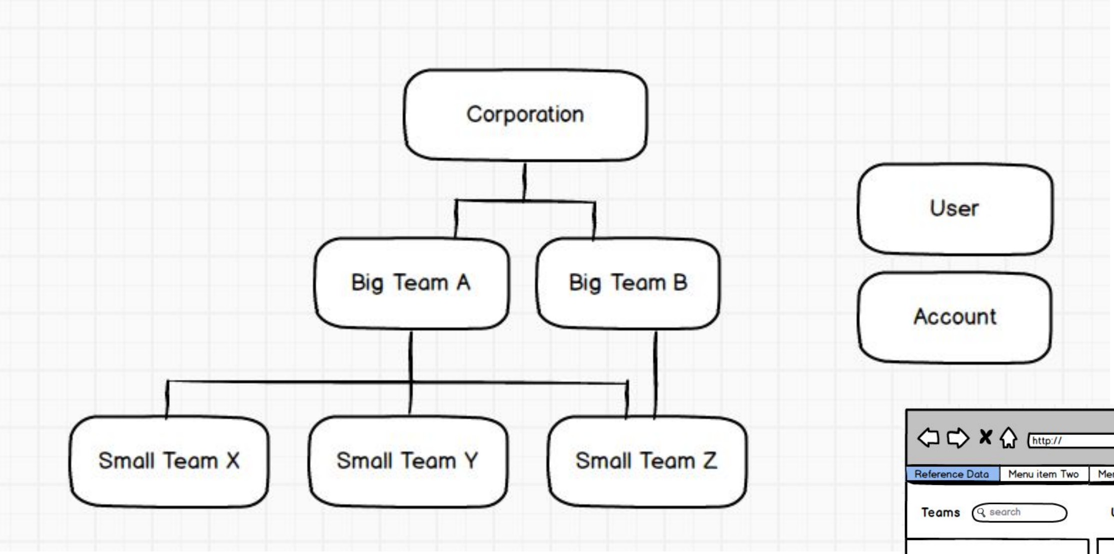


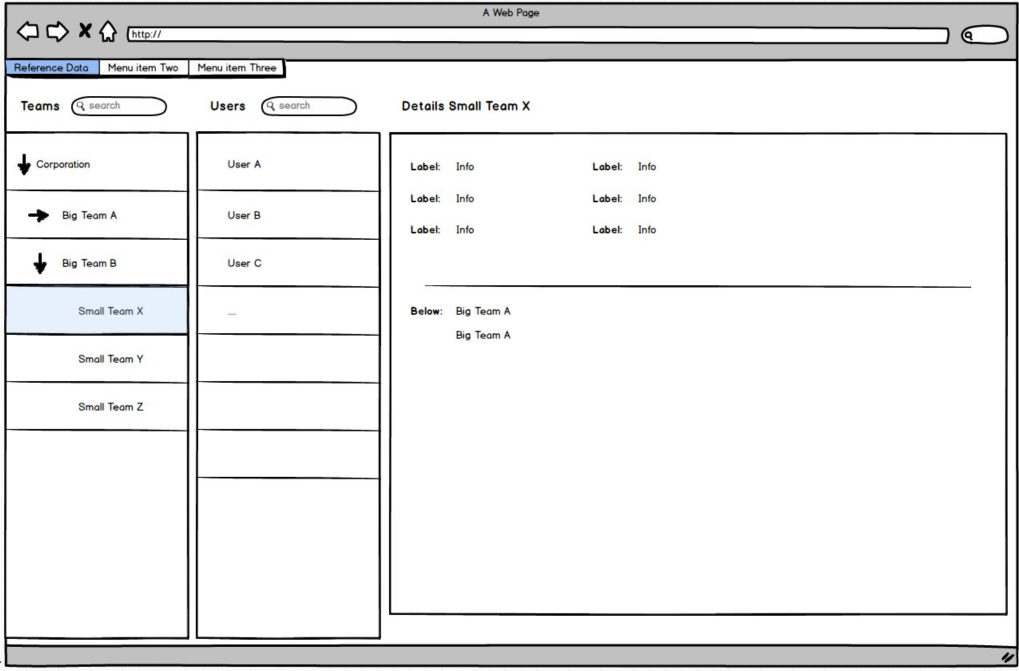


In Hierarchical Structures, sometimes referred to as tree structures or hub-and-spoke structures, there is a top down approach or parent/child relationships between pieces of information.

Users start with broader categories of information (parent) and then drill further down into the structure to find narrower, more detailed information (child).

Many users are familiar with structuring information in hierarchies because they see these structures on a daily basis in the way businesses have a formed their lead leadership structure, the way project plans are set-up, and so on.



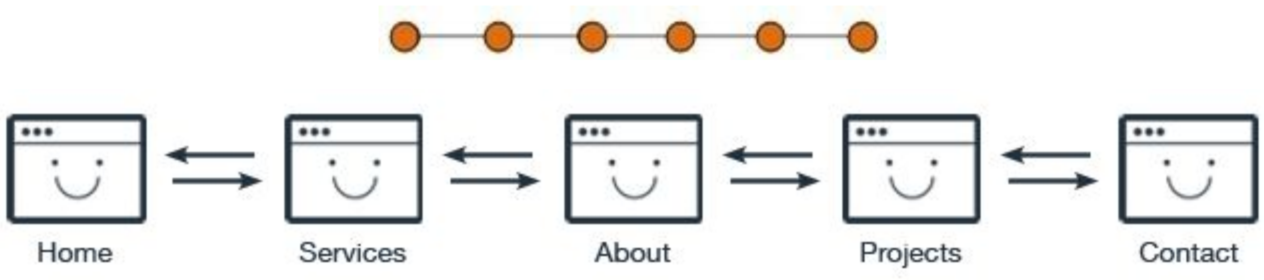


https://ux.stackexchange.com/questions/90872/display-hierarchical-structure-and-corresponding-reference-data

Sequential Structures

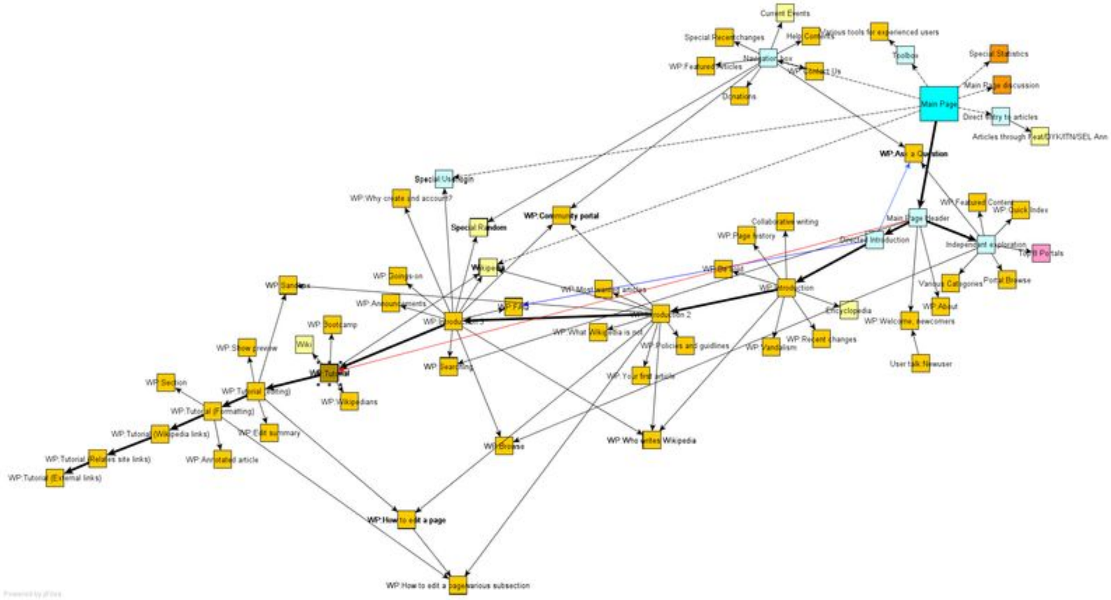
Websites with Sequential Structures require users to go step-by-step, following a specific path through content.

An example of this type of structure is when a user is attempting to purchase something or are taking a course online. Sequential structures assume that there is some optimal ordering of content that is associated with greater effectiveness or success.



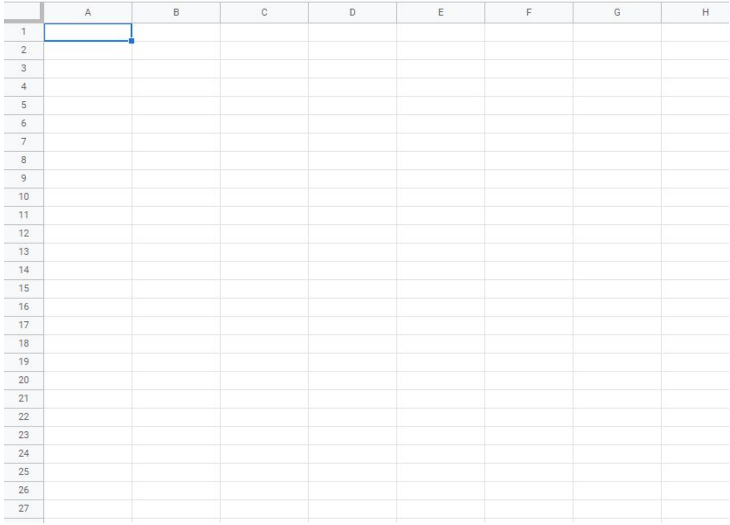
Matrix Structures

A Matrix Structure allows users to determine their own path since content is linked in numerous ways. This type of structure takes full advantage of the principles behind hypertext, or HTML. For example, one user could choose to navigate through a set of content based on date while another navigates based on topic.



Database Model

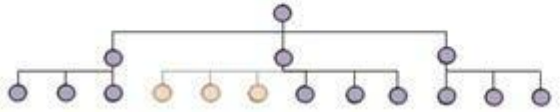
The Database Model takes a bottom-up approach. The content within this structure leans heavily on the linkages created through the content’s metadata. This type of model facilitates a more dynamic experience generally allowing for advanced filtering and search capabilities as well as providing links to related information in the system that has been properly tagged.

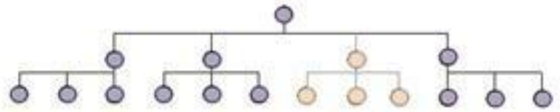


Creating Sustainable Structures

Site/GUI architecture has a long term impact on the site. It’s important to put thought into the structure and ensure that it takes into account content updates in the future. Site managers should keep in mind the following when structuring a site:

Allow room for growth. Creating a site that can accommodate the addition of new content within a section (left image) as well as entire new sections (right image).



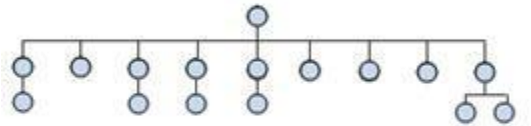


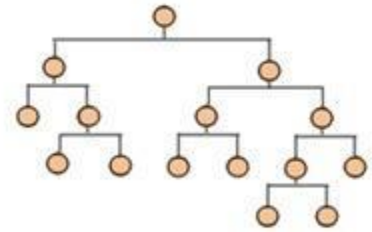
Creating Sustainable Structures

Avoid structures that are too shallow or too deep.

Striking a balance is never easy is an important goal of any architecture. Structures that are too shallow require massive menus.

Users rely on information architects to create logical groupings to facilitate movement throughout the site. In contrast, structures that are too deep bury information beneath too many layers. These structures burden the user to have to navigate through several levels to find the content that they desire.





Information Architecture

Information Architecture

Information architecture (IA) focuses on organizing, structuring, and labeling content in an effective and sustainable way. The goal is to **help users find information** and complete tasks.

To do this, you need to understand how the pieces fit together to create the larger picture, how items relate to each other within the system.

Why a Well Thought Out IA Matters?

According to Peter Morville Site exit disclaimer, the **purpose of your IA is to help users understand where they are, what they've found, what's around, and what to expect.** As a result, your **IA informs the content strategy** through identifying word choice as well as informing user interface design and interaction design through playing a role in the wireframing and prototyping processes.

Information Architecture

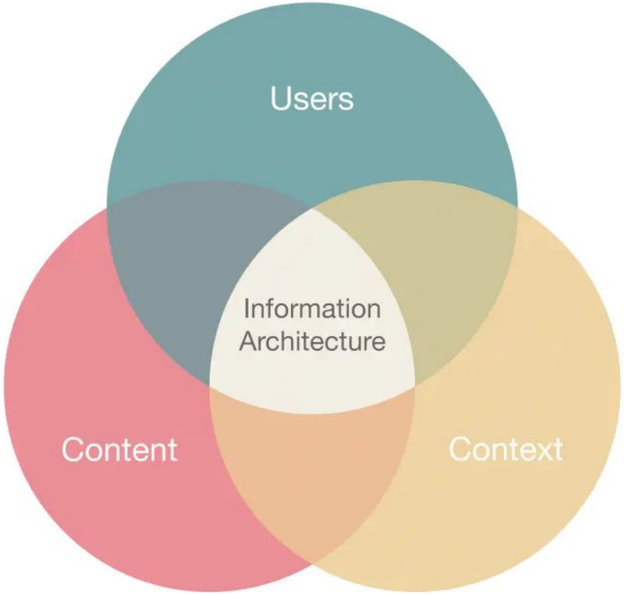
To be successful, you need a diverse understanding of industry standards for creating, storing, accessing and presenting information. Lou Rosenfeld and Peter Morville in their book, Information Architecture for the World Wide Web, note that the main components of IA are:

- **Organization Schemes and Structures:** How you categorize and structure information
- **Labeling Systems:** How you represent information
- **Navigation Systems:** How users browse or move through information
- **Search Systems:** How users look for information

Information Architecture

In order to create these systems of information, you need to understand the interdependent nature of users, content, and context.

Rosenfeld and Morville referred to this as the “information ecology” and visualized it as a venn diagram.



Each circle refers to:

- **Context:** business goals, funding, politics, culture, technology, resources, constraints
- **Content:** content objectives, document and data types, volume, existing structure, governance and ownership
- **Users:** audience, tasks, needs, information-seekir experience

Organization Schemes

Organization schemes have to do with how you are going to categorize your content and the various ways you'll create relationships between each piece. Most content can be categorized in multiple ways.

Schemes can be broken down into **Exact and Subjective.**

Depending on the content, it’s conceivable that the site may combine schemes as opposed to treating them independently.

Exact Organization Schemes

Exact organization schemes objectively divide information into mutually exclusive sections.

These systems comparatively are easy for information architects to create and categorize content within. However, they can be a challenge at times for users.

It requires that the user understands how what they are looking for fits within the model.

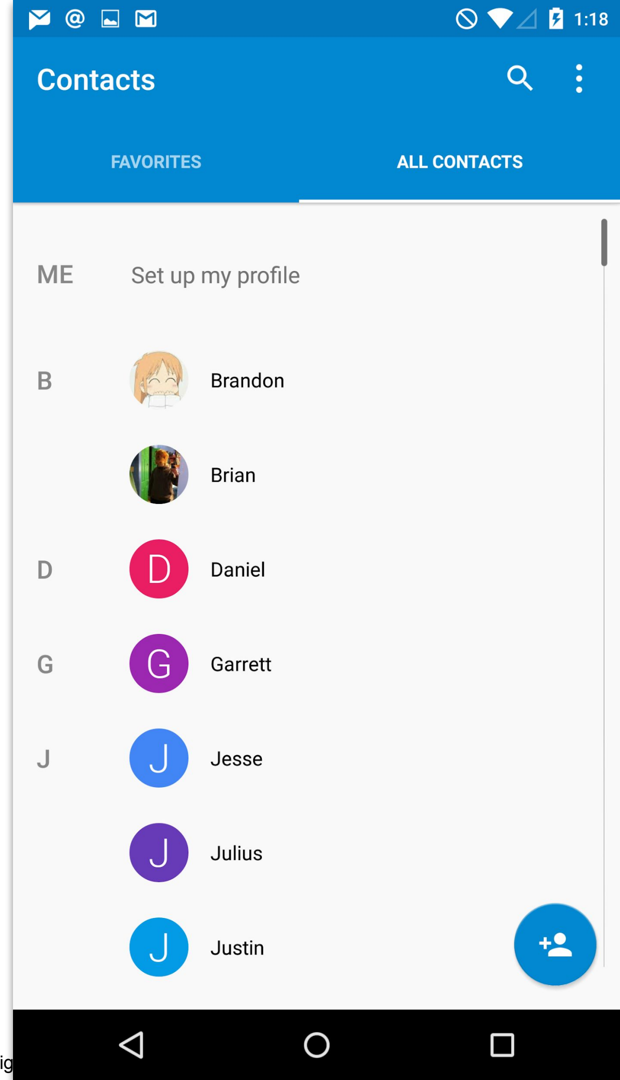
Examples of exact organizational structures include:

Exact Organization Schemes

Alphabetical schemes make use of our 26-letter alphabet for organizing their contents.

For this type of scheme to be successful, it is important that the content labeling matches the words that users are looking for.

Sometimes, alphabetical schemes in the form of an A-Z index serve as secondary navigational components to supplement content’s findability that is otherwise organized.

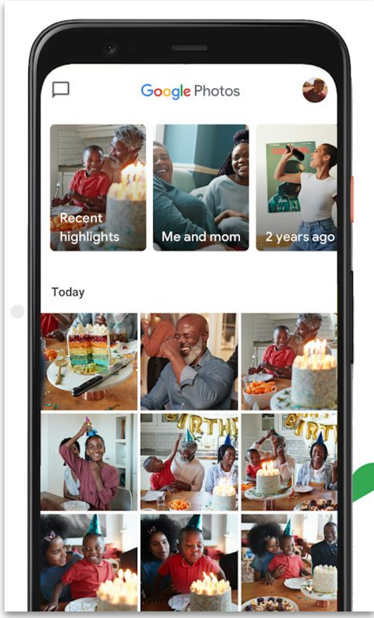


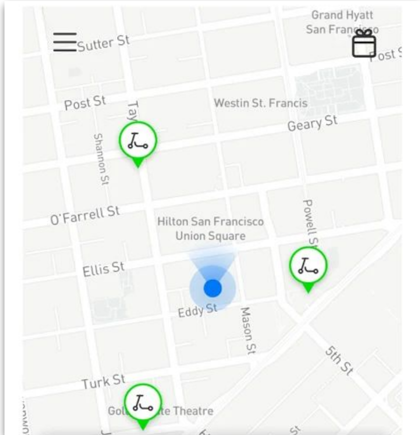
Exact Organization Schemes

Chronological schemes organize content by date. For these schemes to be successful there must be agreement about when the subject of the content took place.

Geographical schemes organize content based on place. Unless there are border disputes, this type of scheme is fairly straightforward to design and use.

Often these types of schemes serve as a good supplemental way to navigate a site that that is otherwise organized. For example, you may choose to provide a map to display information or an A-Z index to get to topics grouped primarily by one of the following subjective schemes.





Subjective Organization Schemes

Subjective organization schemes **categorize information in a way that may be specific** to or defined by the organization or field.

Although they are difficult to design, **they are often more useful than exact organization schemes.**

When information architects take the time to consider the user’s mental models and group the content in meaningful ways, these types of schemes can be quite effective in producing conversions.

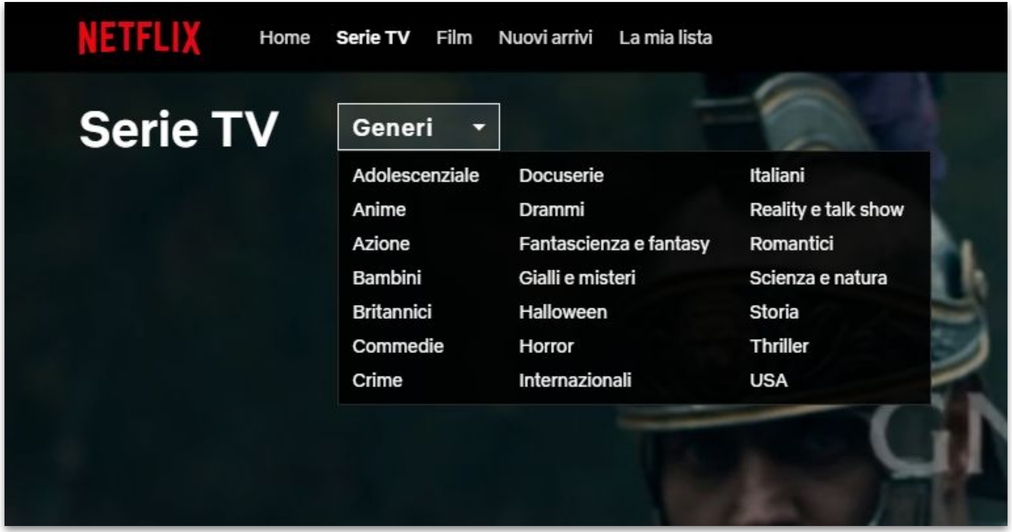
This type of categorization can also help facilitate learning by helping users understand and draw connections between pieces of content.

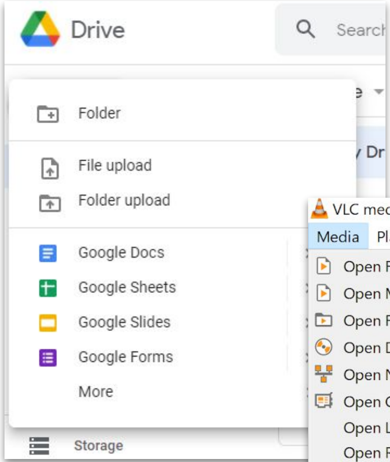
Subjective Organization Schemes

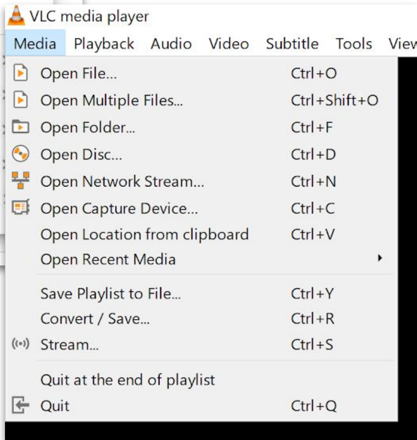
Examples of subjective schemes include the following:

Topic schemes organize content based on the specific subject matter.

Task schemes organize content by considering the needs, actions, questions, or processes that users bring to that specific content.



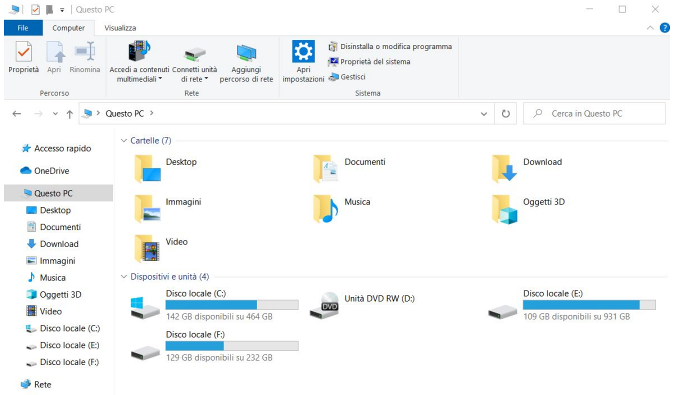




Subjective Organization Schemes

Audience schemes organize content for separate segments of users. Audience schemes can be closed or open, meaning that users are able to navigate from one audience to another. This type of scheme does present challenges unless the content lends itself to users very easily self-identifying to which audience they belong and perhaps not fitting multiple audience profiles.

Metaphor schemes help users by relating content to familiar concepts. This is used in interface design (folders, trash, etc) but can pose challenges when used as the site's primary organization scheme.



Challenges of Creating Hybrids

Implementing schemes independently has its advantages because it keeps things simple for the user.

They can identify the categorization and form a mental model that can be quickly understood.

Mixing schemes by creating hybrids can cause confusion for users.

This is often proposed as a solution when project teams cannot agree on a single scheme to categorize the content.

Interfaces’ layout and components

The Document Object Model (DOM)

The Document Object Model, usually referred to as the DOM, is an essential part of making websites interactive.

It is an interface that allows a programming language to manipulate the content, structure, and style of a website.

JavaScript is (can be) the client-side scripting language that connects to the DOM in an internet browser

Almost any time a website performs an action, such as rotating between a slideshow of images, displaying an error when a user attempts to submit an incomplete form, or toggling a navigation menu, it is the result of JavaScript (or another web language) accessing and manipulating the DOM.

more info https://www.taniarascia.com/introduction-to-the-dom/

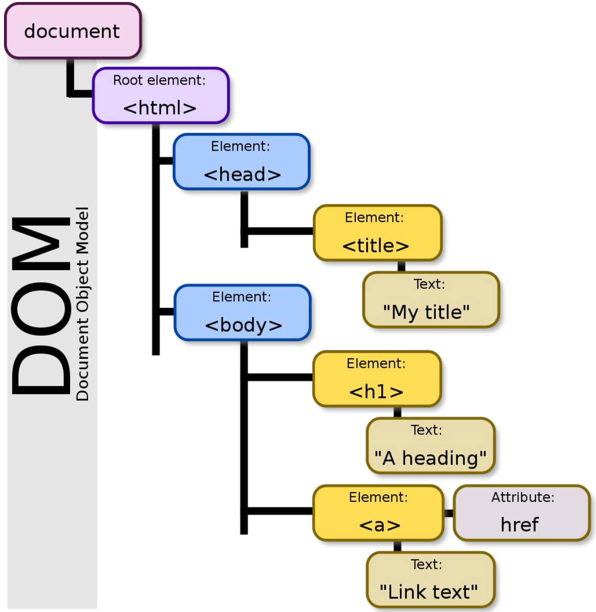
The Document Object Model (DOM)

The DOM is a cross-platform and language-independent interface that treats an XML or HTML document as a tree structure wherein each node is an object representing a part of the document.

The DOM represents a document with a logical tree. Each branch of the tree ends in a node, and each node contains objects.

DOM methods allow programmatic access to the tree; with them one can change the structure, style or content of a document.

Nodes can have event handlers attached to them. Once an event is triggered, the event handlers get executed.



The Document Object Model (DOM)

The principal standardization of the DOM was handled by the World Wide Web Consortium, which last developed a recommendation in 2004.

WHATWG took over the development of the standard, publishing it as a living document. The W3C now publishes stable snapshots of the WHATWG standard.

DOM in Web Browser

To render a document such as a HTML page, most web browsers use an internal model similar to the DOM.

The nodes of every document are organized in a tree structure, called the DOM tree, with the topmost node named as "Document object".

When an HTML page is rendered in browsers, the browser downloads the HTML into local memory and automatically parses it to display the page on screen.

DOM in JavaScript

When a JavaScript web page is loaded, the browser creates a Document Object Model of the page, which is an object oriented representation of an HTML document that acts as an interface between JavaScript and the document itself.

This allows the creation of dynamic web pages, because within a page JavaScript can:

- add, change, and remove any of the HTML elements and attributes
- change any of the CSS styles
- react to all the existing events
- create new events

Interfaces’ components

When designing your interface, try to be consistent and predictable in your choice of interface elements. Whether they are aware of it or not, users have become familiar with elements acting in a certain way, so choosing to adopt those elements when appropriate will help with task completion, efficiency, and satisfaction.

Interface elements include but are not limited to:

- **Input Controls:** checkboxes, radio buttons, dropdown lists, list boxes, buttons, toggles, text fields, date field
- **Navigational Components:** breadcrumb, slider, search field, pagination, slider, tags, icons
- **Informational Components:** tooltips, icons, progress bar, notifications, message boxes, modal windows
- **Containers:** accordion

Continue: [here]

Personas, Requirements, user stories, scenarios and use cases

Personas, scenarios, user stories and use case

source: https://www.justinmind.com/blog/user-personas-scenarios-user-stories-and-storyboards-whats-the-difference/

4 user research methods to help you create reliable and realistic representations of your target users and design accordingly

USER CENTERED DESIGN!

PERSONAS

PERSONAS

A **user persona** is an **archetype or character** that represents a potential user of your website or app.

In user centered-design, personas help the design team to target their designs around users.

they are an integral part of the user experience research phase of software development.

In user research, UXers will gather data related to the **goals and frustrations** of their potential users. Then, they create personas to put that data into context.

PERSONAS

There is usually more than one type of user who will interact with your website or app, and creating personas **helps to scope out the range of users**.

For UX teams, introducing persona development into the design process helps them learn about the spectrum of goals and needs of their users.

A designer’s checklist if you like.

PERSONAS

User persona development helps us **bridge the gap between the company and its users** by allowing us to measure true user behavior and figure out what their end goals might be.

It **drives design decisions** by allowing software teams to get a deeper **understanding of the users** who will be using the systems they are building.

But while they might be useful, creating user personas isn’t always fun and games.

PERSONAS

Creating a user persona starts with user research.

By observing users, UXers can **understand their behavior and motivations**, and then design accordingly.

There are plenty of user research techniques that help UXers capture this information, such as:

- task analysis (card sorting, first click testing etc.)
- feedback (contextual interviews and focus groups)
- prototyping (experimenting with ideas prior to developing them)

PERSONAS

How many personas should I define?

user persona's design should ideally be based around the Pareto Principle.

Focus on **that 20% of your user-base that will use/buy 80% of your features/products, or that will account for 80% of your revenue.**

Pareto principle *states that, for many events, roughly 80% of the effects come from 20% of the causes*

PERSONAS

Upon observing users, UX designers split up the test data into possible user archetypes, or user personas.

Then all this information is put into context in a **user persona template**.

Designers can only respond to their users' needs once they know what those needs are.

examples:

https://simplicable.com/new/user-persona

https://www.justinmind.com/blog/user-personas-which-game-of-thrones-character-is-yours/

Personas recap

https://www.smaply.com/blog/personas

REQUIREMENTS

Requirements

a requirement is **a service, function or feature that a user needs.**

Requirements can be functions, constraints, business rules or other elements that **must be present** to meet the need of the intended users.

Requirements

For example:

In a training company with its own training centre:

- **The Course Manager** has a requirement to **schedule training courses** and reserve rooms, in order to make available courses visible and to ensure courses run effectively
- The Training **Centre Manager** has a requirement to **keep track of what training is running**, in order to ensure appropriate allocation of trainers to courses
- The **Financial Accountant** has a requirement to **maximise the amount of time that the training rooms are in use**, in order to maximise revenue from the rooms

Requirements

However, the attempt to define a full and detailed set of requirements too early in a project often proves to be counterproductive, restrictive and wasteful.

It is not possible to define all of the detailed requirements at the outset of a long project.

The business environment changes as time progresses; new requirements and opportunities present themselves. As the project progresses, the team understand more about the business need.

Defining detailed requirements too early means either needing to change the specification later, which wastes the original work, or delivering to the originally-specified requirements and subsequently failing to adequately satisfy the business need.

Requirements

The success of any solution is the product of two aspects:

- **what it does** (functionality, features)
- **how well it performs against defined parameters** (non-functional attributes, acceptance criteria, service levels)

Categories of Requirements

Functional Requirements (FRs) express **function or feature and define what** is required, e.g.

- Visit customer site
- Obtain conference venue

The requirements do not state how a solution will be physically achieved.

- Drive to customer site is one possible solution. However, fly to customer site or travel by train to customer site are potential alternative solutions which may be worth consideration
- Build conference centre is one possible solution. Hire a hotel room is an alternative solution

Categories of Requirements

Non-functional Requirements (NFRs) define how well, or to what level a solution needs to behave.

They describe solution attributes such as security, reliability, maintainability, availability (and many other "...ilities"), performance and response time, e.g.

- responding within 2 seconds
- being available 24 hours per day, every day

Categories of Requirements

NFRs may be:

- Solution-wide or impacting a group of functional requirements: e.g.
  - All customer facing functionality must carry the company logo
  - All customer-facing functionality must respond within 2 seconds to requests
- Related to a particular functional requirement, e.g.
  - Hire conference venue might have NFRs of accessibility, security, and availability

USER STORIES

User stories

A user story is a **short statement or abstract that identifies the user and their need/goal.** It determines who the user is, what they need and why they need it.

<u>There is usually one user story per user persona.</u>

there are often multiple user personas – it’s a good thing that user stories are brief!

stories are at the center of the user experience. Why? They put things in context and focus on the ‘holistic’ rather than the ‘artifact’.

A User Story is a requirement expressed from the perspective of an end-user goal.

User stories

For example:

“As a UX Manager, John oversees all the design projects, including assets creation and prototyping efforts, at the design consultancy where he works. He needs easy access to a design tool that allows him to centralize UI libraries so that multiple designers to work simultaneously on a prototype.”

Requirements example: ***The Course Manager*** *has a requirement to* ***schedule training courses*** *and reserve rooms, in order to make available courses visible and to ensure courses run effectively*

User stories

User stories help to document practical information about users, such as the different needs and motivations for accessing a website or app.

They also help the development team estimate a roadmap needed to deliver the end product.

User stories

How to write a user story:

It’s super simple to write a user story.

“As a [role], I want [feature] because [reason].”

For example: “As UX Manager, John wants centralized assets management so that his designers are in sync.”

this approach helps you to think about who a certain feature is built for and why

Who writes user stories?

Anyone can write user stories.

It's the **product owner's responsibility** to make sure a product backlog of user stories exists, but **that doesn't mean that the product owner is the one who writes** them.

Over the course of a good agile project, you should expect to have user story examples **written by each team member**.

Also, note that who writes a user story is far less important than who is involved in the discussions of it.

User stories

One of the benefits of user stories is that they can be written at varying levels of detail.

We can write a user story to cover large amounts of functionality. These **large user** stories are generally known as **epics**.

Here is an epic agile user story example from a desktop backup product:

- As a user, I can backup my entire hard drive.

How is detail added to user stories?

Because an epic is generally too large for a design team to complete in one iteration, it is split into multiple smaller user stories before it is worked on.

The epic in the previous slide could be split into dozens (or possibly hundreds), including these two:

- As a power user, I can specify files or folders to backup based on file size, date created and date modified.
- As a user, I can indicate folders not to backup so that my backup drive isn't filled up with things I don't need saved.

How is detail added to user stories?

Detail can be added to user stories in two ways:

- By splitting a user story into multiple, smaller user stories.
- By adding “conditions of satisfaction.”

When a relatively large story is split into multiple, smaller agile user stories, it is natural to assume that detail has been added. After all, more has been written.

The conditions of satisfaction is simply a high-level acceptance test that will be true after the agile user story is complete.

How is detail added to user stories?

Consider the following as another agile user story example:

As a vice president of marketing, I want to select a holiday season to be used when reviewing the performance of past advertising campaigns so that I can identify profitable ones.

Detail could be added to that user story example by adding the following conditions of satisfaction:

- Make sure it works with major retail holidays: Christmas, Easter, President’s Day, Mother’s Day, Father’s Day, Labor Day, New Year’s Day.
- Support holidays that span two calendar years (none span three).
- Holiday seasons can be set from one holiday to the next (such as Thanksgiving to Christmas).
- Holiday seasons can be set to be a number of days prior to the holiday.

User Stories recap

??

SCENARIOS

Scenarios

A scenario is a situation that captures how users perform tasks on your site or app.

Scenarios describe the user's motivations for being onsite (their task or goal) and/or a question they need answered, and suggest possible ways to accomplish these objectives.

It is essentially a development of the user story, and can relate to multiple target users.

However, scenarios can also be broken down into use cases that describe the flow of tasks that any one user takes in a given functionality or path.

Scenarios

For example, a scenario could outline how John uses a mobile app to buy a ticket to a design workshop whilst on his way to work.

Scenarios help stakeholders envision the ideas of the design team by providing context to the intended user experience – frequently bridging communication gaps between creative and business thinking.

For the design team, scenarios help them imagine the ideal solution for a user's problem.

"Scenarios are the engine we use to drive our designs." (UX influencer, Kim Goodwin)

What to Consider When Writing Scenarios

Good scenarios are **concise** but answer the following key questions:

- **Who is the user?** Use the personas that have been developed to reflect the real, major user groups coming to your site.
- **Why does the user come to the site?** Note what motivates the user to come to the site and their expectations upon arrival, if any.
- **What goals does he/she have?** Through task analysis, you can better understand the what the user wants on your site and therefore what the site must have for them to leave satisfied.

<u>**Some**</u> scenarios also answer: **How can the user achieve** their goals on the site? Define how the user can achieve his/ her goal on the site, identifying the various possibilities and any potential barriers.

How to write a scenario

Scenario planning starts with scenario mapping.

The design team, developers and product owner will meet to exchange ideas and create a strategy based on their user personas.

With the **primary user defined through persona** development, they can now consider **the key task that the user hopes to achieve**.

The next step is to perform a scenario analysis, **put the user's goals into context** and walk through the steps that the user would take.

How to write a scenario

Creating Scenarios requires a special mindset.

It is about **focusing on the users' goals**: what will they try to accomplish on a website or inside an app?

Additionally, it is also important to think about their context, their prior knowledge and background.

How to write a scenario

Thanks to Scenarios, we can determine:

- the most important points to focus on during the UX design process
- which steps of the process would require additional help to your users
- the main needs and motivations of your users.

Scenarios are built upon User Story: these short statements describe what a certain User Persona needs, and why. <u>Scenarios take User Stories to the next level by adding the interaction with the product or service to the story.</u>

How to write a scenario

https://uxknowledgebase.com/scenarios-43e05671b07

Type of scenarios

https://www.usability.gov/how-to-and-tools/methods/scenarios.html

Scenarios recap

https://www.interaction-design.org/literature/topics/user-scenarios

USE CASES

Use Cases

A use case is a written description of how users will perform tasks on your app.

It outlines, from a user's point of view, a system's behavior as it responds to a request.

Each use case is represented as a sequence of simple steps, beginning with a user's goal and ending when that goal is fulfilled.

Scenarios vs Use Cases

A Scenario involves a situation that may have single or multiple actors that take a given functionality or path to achieve their goal

A use case involves an actor and **the flow** that a particular actor takes in a given functionality or path. These often get grouped so you have a "set" of use cases to account for each scenario.

The main difference is "perspective".

The use case is more granular than the scenario.

it usually involves coming up with a scenario and then defines all the use cases that fit into that particular scenario.

Use cases

Use cases add value because they help explain how the system should behave and in the process, they also help brainstorm what could go wrong.

They provide a list of goals and this list can be used to establish the cost and complexity of the system.

Project teams can then negotiate which functions become requirements and are built.

Use cases

What Use Cases Include	What Use Cases Do NOT Include
• Who is using the website • What the user want to do • The user's goal • The steps the user takes to accomplish a particular task • How the website should respond to an action	• Implementation-specific language • Details about the user interfaces or screens.

Elements of a Use Case

Depending on how in depth and complex you want or need to get, use cases describe a combination of the following elements:

- **Actor** – anyone or anything that performs a behavior (who is using the system)
- **Stakeholder** – someone or something with vested interests in the behavior of the system under discussion (SUD)
- **Primary Actor** – stakeholder who initiates an interaction with the system to achieve a goal
- **Preconditions** – what must be true or happen before and after the use case runs.

Elements of a Use Case

- **Triggers** – this is the event that causes the use case to be initiated.
- **Main success scenarios [Basic Flow]** – use case in which nothing goes wrong.
- **Alternative paths [Alternative Flow]** – these paths are a variation on the main theme. These exceptions are what happen when things go wrong at the system level.

Use case?

https://www.youtube.com/watch?v=Ct-lOOUqmyY&ab_channel=NowI%27veSeenEverything

How to write a use case

https://www.usability.gov/how-to-and-tools/methods/use-cases.html

Kenworthy (1997) outlines the following steps:

1. Identify who is going to be using the website.
2. Pick one of those users.
3. Define what that user wants to do on the site. Each thing the use does on the site becomes a use case.
4. For each use case, decide on the normal course of events when that user is using the site.

How to write a use case

https://www.usability.gov/how-to-and-tools/methods/use-cases.html

5. Describe the basic course in the description for the use case. Describe it in terms of what the user does and what the system does in response that the user should be aware of.

6. When the basic course is described, consider alternate courses of events and add those to "extend" the use case.

7. Look for commonalities among the use cases. Extract these and note them as common course use cases.

8. Repeat the steps 2 through 7 for all other users.

The Takeaway

Engaging in user persona, user story, scenario and/or use case development will help you to identify key information about your users and build products that will delight your users time and time again.

Everything we do to get closer to users is a step in the right direction.

examples

https://uxplanet.org/5-examples-of-brilliant-ux-design-8e847bf0bcc0

https://uxdesign.cc/fitbit-a-usability-case-study-b23e4c539c3c

https://uxplanet.org/foodmix-cooking-app-ux-case-study-d046c1f5896b

Innovations Methods and Frameworks

Innovation

Innovation is commonly defined as the "**carrying out of new combinations**" that include "the introduction of new goods, ... new methods of production, ... the opening of new markets, ... the conquest of new sources of supply ... and the carrying out of a new organization of any industry"

However, many scholars and governmental organizations has given their own definition of the concept.

Some common element in the different definitions is **a focus on newness, improvement and spread.**

Innovation

An innovation is something original and more effective and, as a consequence, new, that **"breaks into"** the market or society.

Innovation is related to, but not the same as, invention: innovation is more apt to involve the practical implementation of an invention to **make a meaningful impact in a market or society,** and not all innovations require a new invention.

Technical Innovation often manifests itself via the engineering process when the problem being solved is of a technical or scientific nature.

It is not possible to innovate without a HCD approach! a product or service in order to be innovative must be usable!

Sustaining innovation

Most of the innovation processes are based on incremental innovation. Minor improvements of existing products.

- step by step process
- low risk
- low speed
- no changes to company organization required
- no user re-skilling required
- low probability to change/scale-up the business
- target user and market sector stable

Disruptive Innovation

A disruptive innovation is **an innovation that creates a new market** and value network and eventually **disrupts an existing market** and value network, displacing established market-leading firms, products, and alliances.

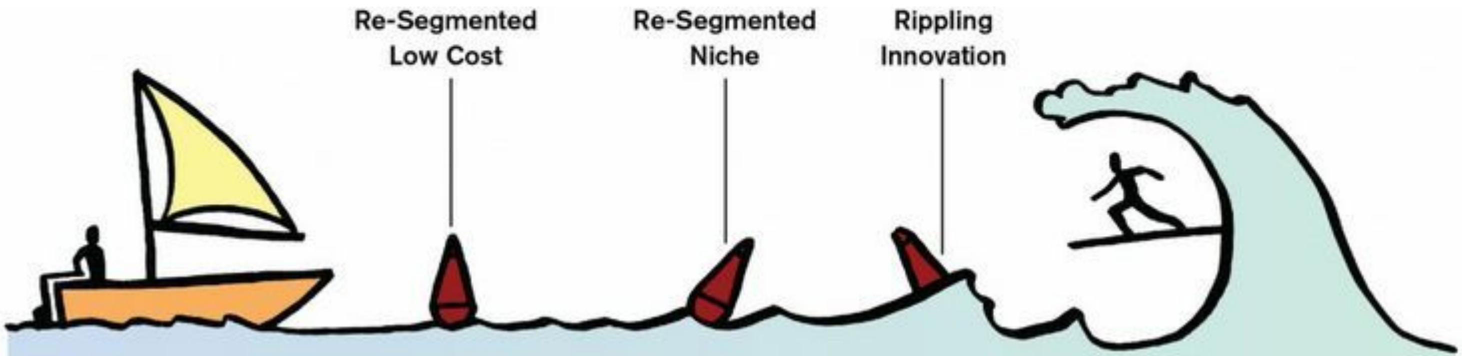
The term was defined and first analyzed by the American scholar Clayton M. Christensen and his collaborators beginning in 1995, and has been called the most influential business idea of the early 21st century.

The term is now generalized to identify disruptive science and technological advances.

Disruptive Innovation

Not all innovations are disruptive, even if they are revolutionary.

For example, the first automobiles in the late 19th century were not a disruptive innovation, because early automobiles were expensive luxury items that did not disrupt the market for horse-drawn vehicles. The market for transportation essentially remained intact until the debut of the lower-priced Ford Model T in 1908. The mass-produced automobile was a disruptive innovation, because it changed the transportation market, whereas the first thirty years of automobiles did not.



https://hcldr.wordpress.com/2017/01/10/disruptive-innovation-in-healthcare/

Sustaining Innovation	Disruptive Innovation
Problem is well understood	Problem not well understood
Existing Market	New Market
Innovation improves performance, lower cost, incremental changes	Innovation is dramatic and game changing
Customer is believable	Customer doesn't know
Market is predictable	Market is unpredictable
Traditional business methods are sufficient	Traditional business methods fail

Disruptive Innovation and Human Centered Design

Disruptive innovation must be user centered!

No users no innovation!

Methods and Frameworks for Disruptive Innovation

Human Centered Design Process

Human Centered Design Process

IDEO is one of the most innovative and award-winning design firms in the world.

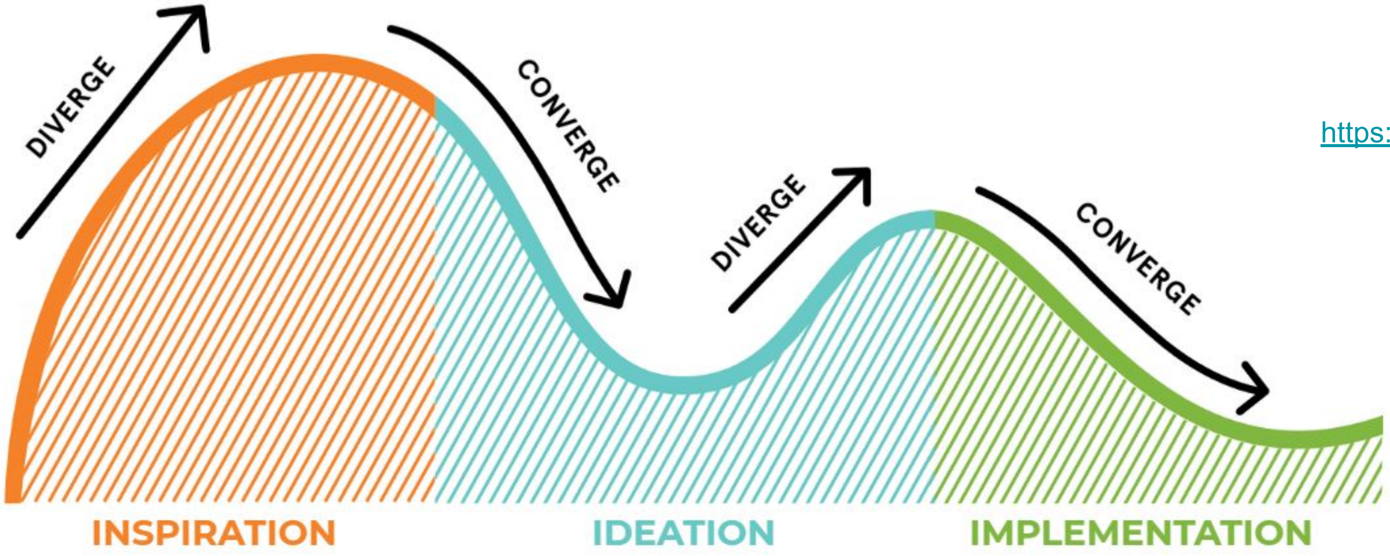
IDEO's main tenet is empathy for the end-user of their products. They believe that the key to figuring out what humans really want lies in doing two things:

- **Observing user behavior:** Try to understand people by observing them. For example, if you're designing a vacuum cleaner, watch people vacuum.
- **Putting yourself in the situation of the end-user:** IDEO does this to understand what the user experience is really like; to feel what their users feel.

Then, they use the information they gain to fuel their designs.

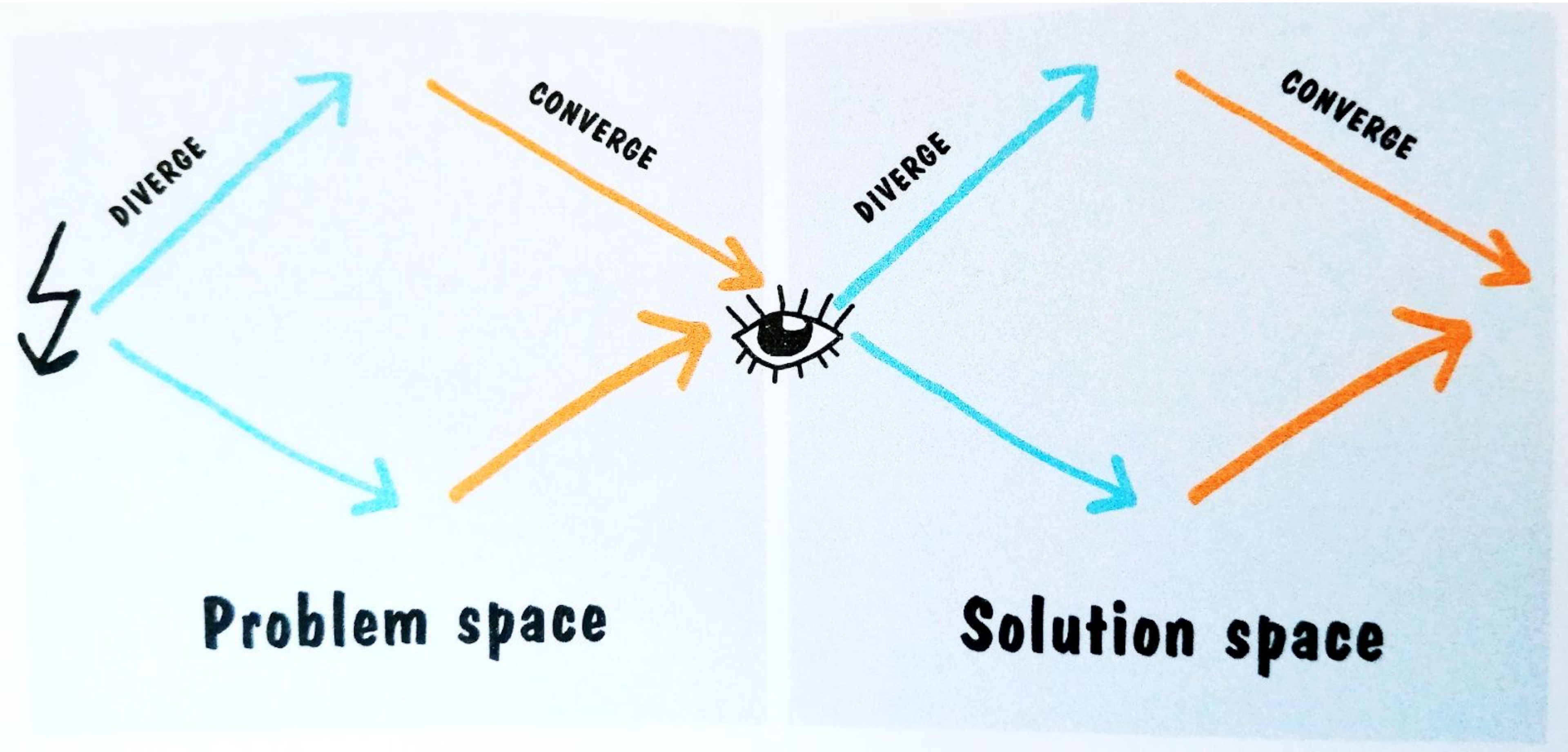
Human Centered Design Process

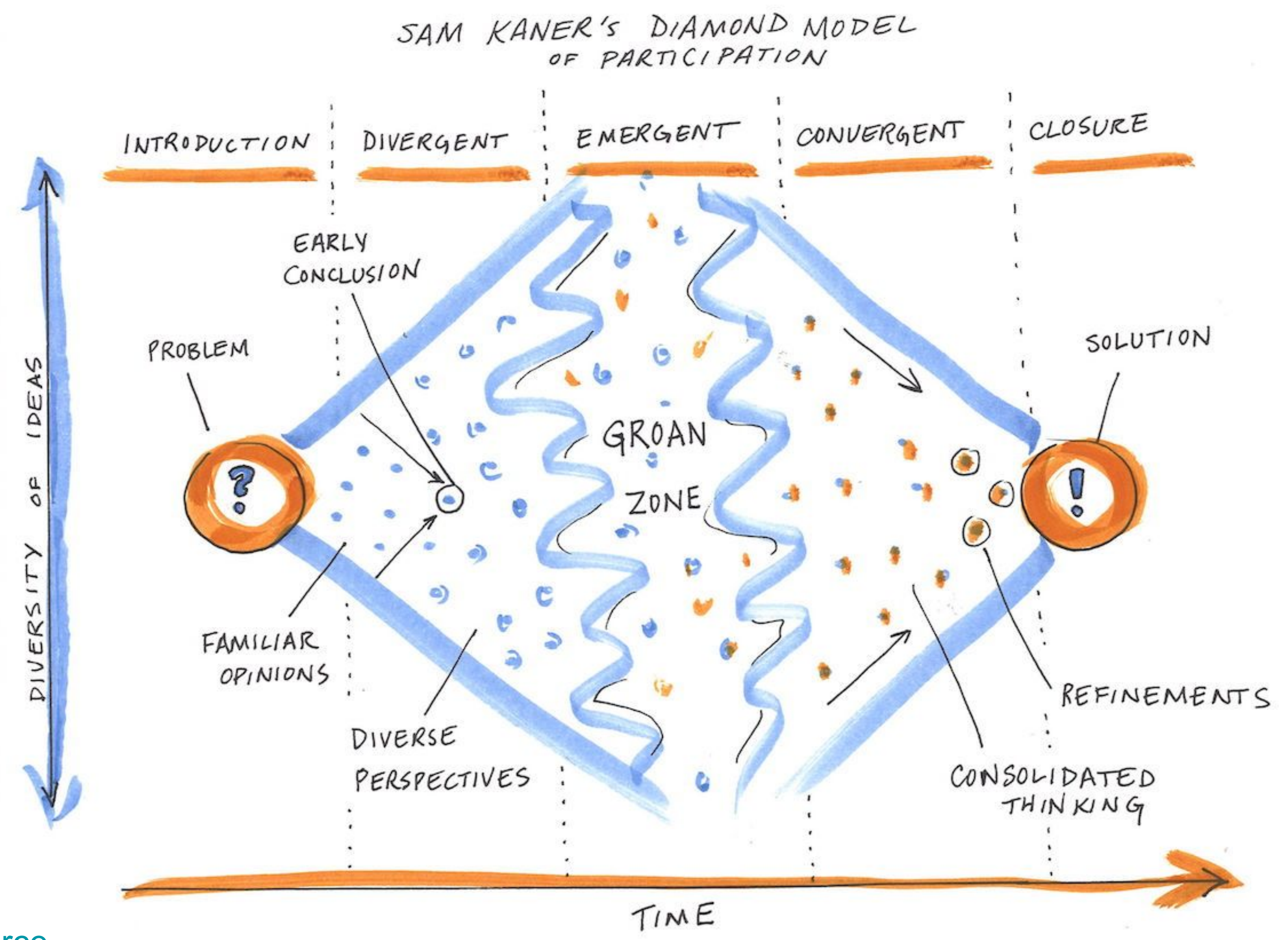
IDEO defines the human centered design process as a creative approach to problem-solving that starts with people and ends with innovative solutions that are tailor-made to suit their needs.



VIDEO
https://vimeo.com/106505300

https://blog.movingworlds.org/human-centered-design-vs-design-thinking-how-theyre-different-and-how-to-use-them-together-to-create-lasting-change/


DIVERGE
CONVERGE
DIVERGE
CONVERGE
Problem space
Solution space



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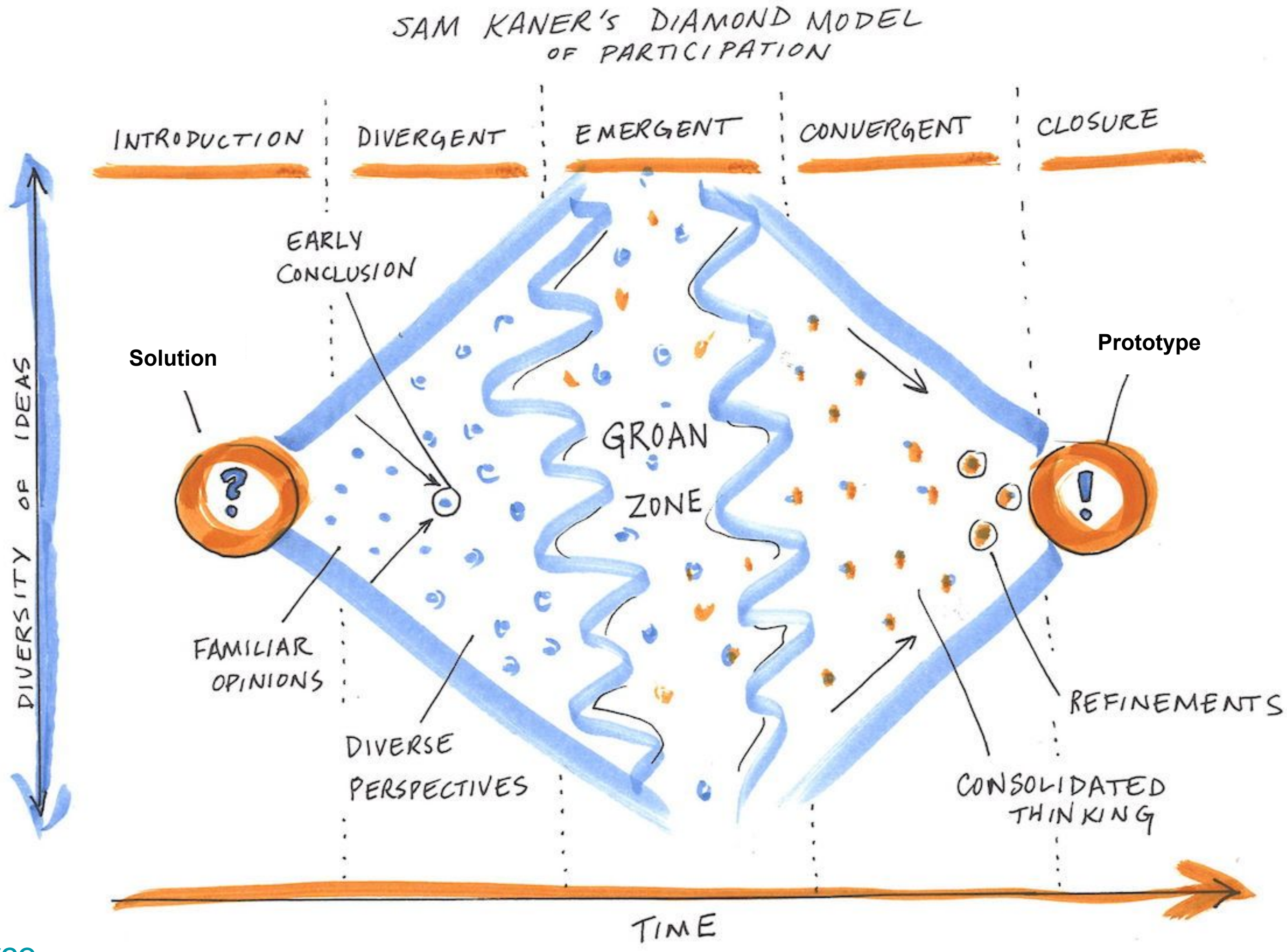


image source

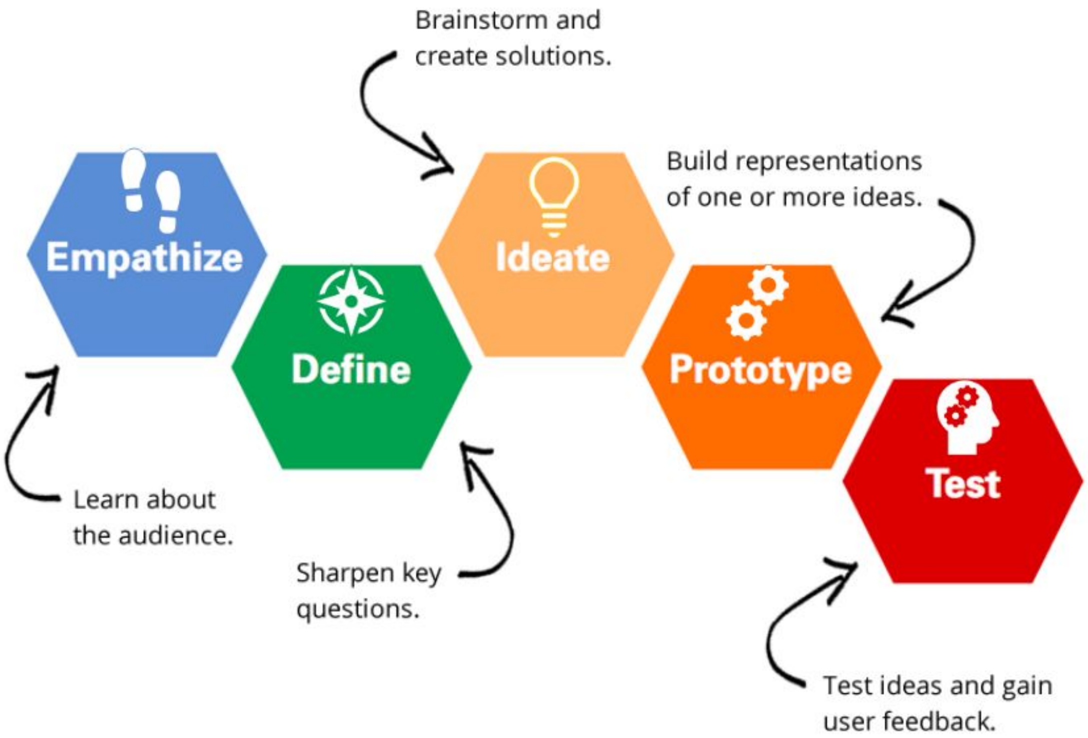
Human Centered Design Process

1. **Inspiration**: The inspiration phase is all about understanding your user's needs and challenges, and dropping any preconceived notions you might have about them. At this stage in the HCD process you need to remove any specific outcomes in mind, and instead open yourself to a wide variety of possible solutions.
2. **Ideation:** After consolidating your research and findings, this phase is about visualizing, retargeting, brainstorming and discussing all the potential solutions. Penning down your ideas in front of you - regardless of how flawed or impractical - helps you and your end-user hone in on what's going to work and what's not. At this stage, you don't want to start off with expensive prototypes - all you need are some basic sketches, lists or small scale models to tap into your creativity without the pressure to produce a polished final product. What's important about this phase is that once you've gotten feedback early, you can reiterate your best ideas until you've made your way to a well-developed concept that works for everyone, and is aimed at impacting your user in a positive way.
3. **Implementation:** The first two phases were meant to set the ground for you and your team to find a concept that feels right, before moving forward and setting aside money to build and run rapid prototypes. In this phase, this contains the tail end of the pre-production phase, where a high fidelity prototype is put together for your users to try out, as well as the actual production of the object (or coding, for web and app-based projects). This is a good time to create a business model around the concept, make necessary partnerships and prepare your product for real-world use.

Design Thinking

Design Thinking

Popularized by Stanford's d.school, is a process that you go through to create solutions that will actually be adopted by people.



https://blog.movingworlds.org/human-centered-design-vs-design-thinking-how-theyre-different-and-how-to-use-them-together-to-create-lasting-change/

Design Thinking

Design Thinking is an iterative process in which we seek to understand the user, challenge assumptions, and redefine problems in an attempt to identify alternative strategies and solutions **that might not be instantly apparent with our initial level of understanding.**

At the same time, Design Thinking provides **a solution-based approach to solving problems.**

It is a way of thinking and working as well as a collection of hands-on methods.

Design Thinking

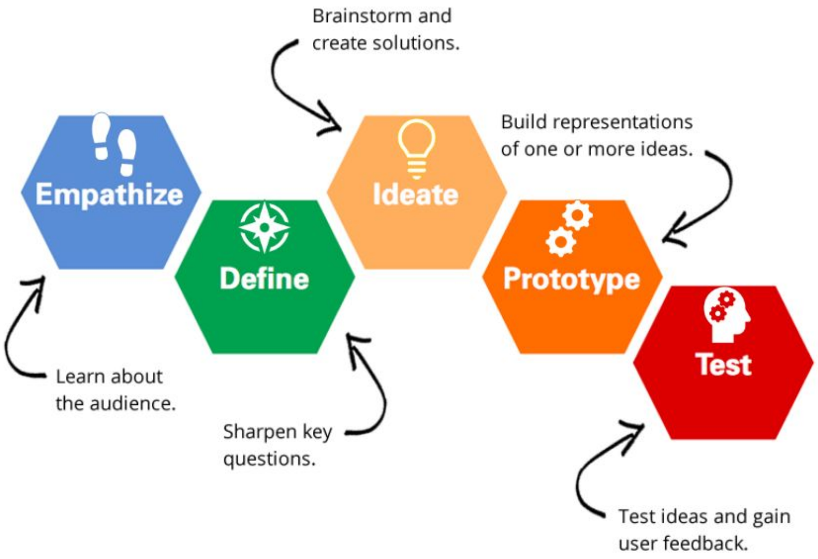
Design Thinking is extremely useful in **tackling problems that are ill-defined or unknown, by re-framing the problem in human-centric ways,** creating many ideas in brainstorming sessions, and adopting a hands-on approach in prototyping and testing.

Design Thinking also involves ongoing experimentation: sketching, prototyping, testing, and trying out concepts and ideas.

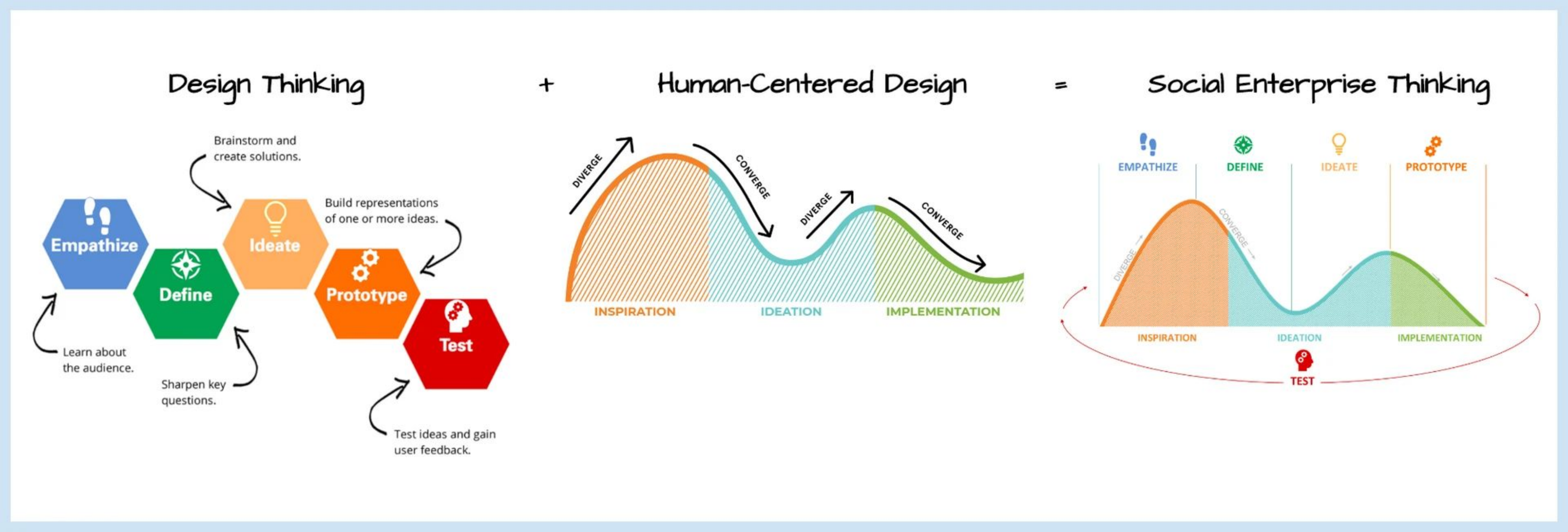
Design Thinking

5 phases:

1. **Empathise:** study your users
2. **Define** your users' needs, their problem, and your insights
3. **Ideate** by challenging assumptions and creating ideas for innovative solutions
4. **Prototype**
5. **Test**



HCD process + Design Thinking



Design Thinking vs HCD

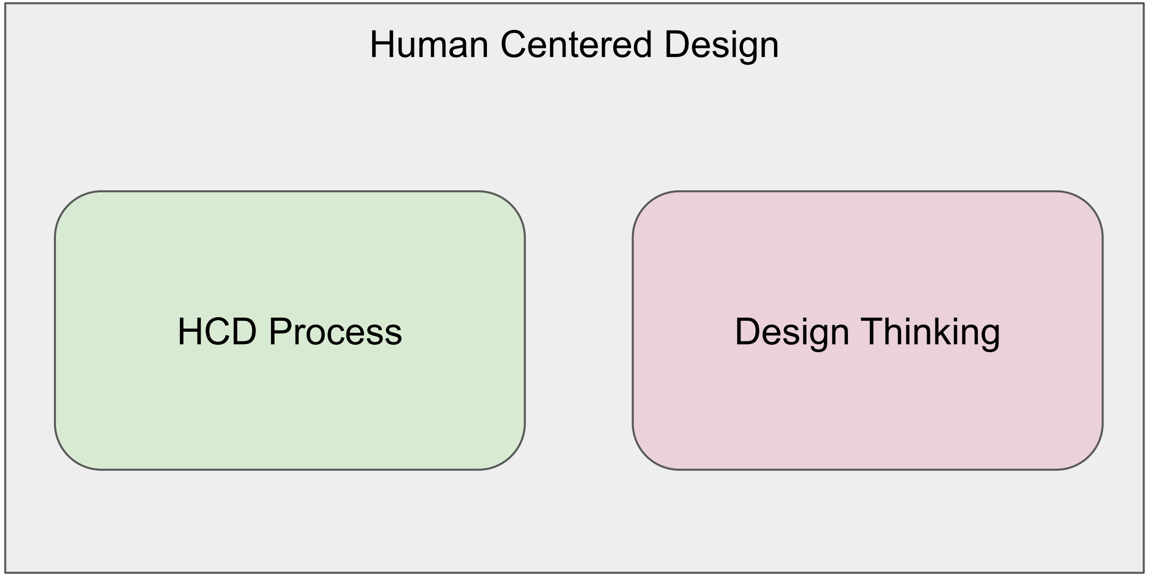
To make this more clear, any business can use **Design Thinking to build a solution that is capable of making money.**

For example, a company may use Design Thinking to create a video game or TV show for kids.

Applying Human-Centered Design on top of this will ensure that the show actually serves the needs of the people watching it.

https://blog.movingworlds.org/human-centered-design-vs-design-thinking-how-theyre-different-and-how-to-use-them-together-to-create-lasting-change/

Design Thinking vs HCD Process vs HCD



HCD is a mindset.
HCD Process e Design Thinking are design methods

House of Cards by Netflix

Before starting the production of House of Card, by analysing their data sets carefully, Netflix noticed that **there was a correlation between fans of the original BBC House of Cards TV show and fans of both Kevin Spacey and director David Fincher.**

Netflix brought together these three elements in one show and, voila, instant cult classic.

https://ideadrop.co/examples-of-data-driven-innovation/

Nappies and beer, Walmart

Beer and baby nappies aren’t two things that you’d usually associate with each other. However, these two products have become infamous in data science circles because of their unique relationship.

In 1992, Karen Heath – an analyst at Teradata – discovered that **men visiting Walmart were extremely likely to buy beer whenever they stopped in to buy babies nappies.** By placing the two items near to each other in the outlet, she was able to increase sales of both items by a significant margin.

https://ideadrop.co/examples-of-data-driven-innovation/

Development methods for innovative products:
Agile, Scrum and Devops

Waterfall Development

Waterfall methodology is a linear project management approach, where stakeholder and customer **requirements are gathered at the beginning** of the project, and then a **sequential project plan** is created to accommodate those requirements.

The waterfall method is so named because **each phase of the project cascades** into the next, following steadily down like a waterfall.

It’s a thorough, structured methodology and one that’s been around for a long time, because it works. Some of the industries that regularly use the waterfall method include construction, IT and software development.

However, the term “waterfall” is usually used in a software context.

Agile

Agile is the ability to create and respond to change. It is a way of dealing with, and ultimately succeeding in, an uncertain and turbulent environment.

It’s really about thinking through how you can understand what’s going on in the environment that you’re in today, identify what uncertainty you’re facing, and figure out how you can adapt to that as you go along.

Agile software development is more than frameworks such as Scrum, Extreme Programming or Feature-Driven Development (FDD).

Agile software development is an umbrella term for a set of frameworks and practices based on the values and principles expressed in the Manifesto for Agile Software Development and the 12 Principles behind it.

AGILE MANIFESTO and Principles

https://agilemanifesto.org/

https://www.agilealliance.org/agile101/12-principles-behind-the-agile-manifesto/

Agile

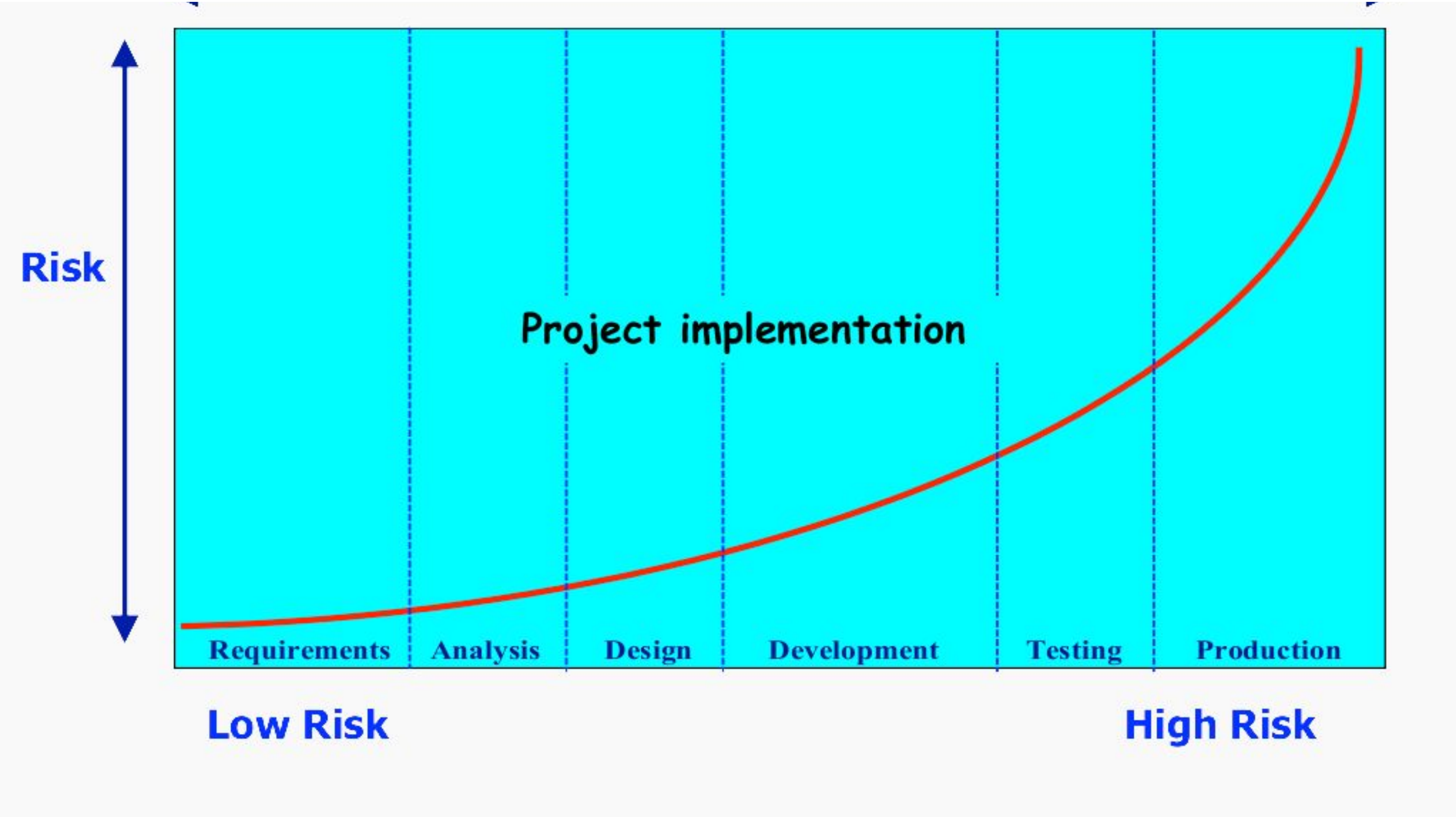
One thing that separates Agile from other approaches to software development is the **focus on the people doing the work and how they work together.**

Solutions evolve through collaboration between self-organizing cross-functional teams utilizing the appropriate practices for their context.

There's a big focus in the Agile software development community on collaboration and the self-organizing team.

Agile is the best building method for HCD and Design thinking where continuous iterations are required

Risk in product development



Scrum

Scrum is an agile framework for developing, delivering, and sustaining complex products, with an initial emphasis on **software** development, although it has been used in other fields including **research, sales, marketing and advanced technologies.**

It is designed for **teams of ten or fewer members**, who break their work into **goals that can be completed within timeboxed iterations, called sprints**, no longer than one month and most commonly **two weeks**.

The Scrum Team track progress in 15-minute time-boxed daily meetings, called daily scrums. At the end of the sprint, the team holds sprint review, to demonstrate the work done, and sprint retrospective to improve continuously.

Scrum

A key principle of Scrum is the dual recognition that **customers will change their minds about what they want or need** (often called requirements volatility) and that there will be unpredictable challenges for which a predictive or planned approach is not suited.

As such, **Scrum adopts an evidence-based empirical approach** – accepting that **the problem cannot be fully understood or defined up front**, and instead focusing on how to maximize the team's ability to deliver **quickly, to respond to emerging requirements**, and to adapt to evolving technologies and changes in market conditions

Scrum

A sprint is the basic unit of development in Scrum. The sprint is a timeboxed effort where the length is agreed and fixed in advance for each sprint and is normally between one week and one month, with two weeks being the most common.

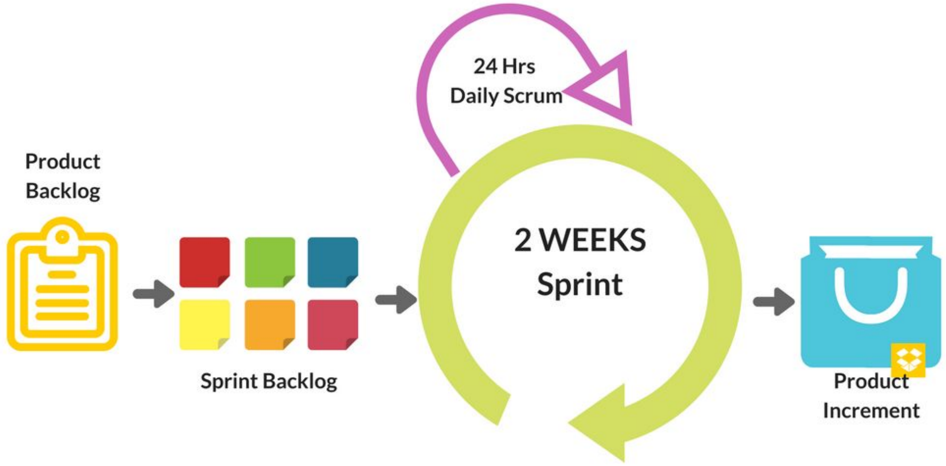
Each sprint starts with a sprint planning event that establishes a sprint goal and the required product backlog items.

Each sprint ends with a sprint review and sprint retrospective, that reviews progress to show to stakeholders and identify lessons and improvements for the next sprints.

Scrum

There are three roles in the Scrum framework.

- **The product owner**, representing the product's stakeholders and the voice of the customer, is responsible for delivering good business results.The product owner defines the product in customer-centric terms (typically user stories), adds them to the Product Backlog, and prioritizes them based on importance and dependencies.
- **The development team**
- **The scrum master** is not a traditional team lead or project manager but acts as a buffer between the team and any distracting influences. The scrum master ensures that the scrum framework is followed.



https://www.agilemarketingitalia.com/2018/05/09/scrum-agile-marketing/

PRETOTYPING

https://www.pretotyping.org/

Pretotype It

Make sure you are building the right *it*
before you build *it* right

Alberto Savoia

First Pretotype Edition
August 2011

http://www.pretotyping.org/

Every year, companies launch thousands of new products of all types and in all markets–with each team believing and hoping that "This is the one." All of these launches are carefully followed and tracked by various market research companies. One such company, Nielsen, has been analyzing thousands of worldwide product launches for a long time. Here is a summary from one yearly report:

One year: 24,543 new products*

Failed	27%
Disappointed	16%
Cancelled	37%
Success	14%
Star	6%
Total	**100%**

80%

* Nielsen

Source: www.pretotyping.org

The law of market failure

- **80-90%** new products fail in the market [1]
- **4/5** startups lose funder's money [2]
- **90%** mobile apps don't produce money
- **78%** project disappear within 4 years
- **16%** to **50%** strategic projects are abandoned
- **47%** companies estimates **50%** of projects fail

The Law of Market Failure:

Most new products will fail in the market,

even if they are competently executed.

In criminal law, a person is presumed innocent until proven guilty. When it comes to market law, we should presume a potential new product to be a failure–at least until we've collected enough objective evidence to make us believe otherwise.

Source: www.pretotyping.org

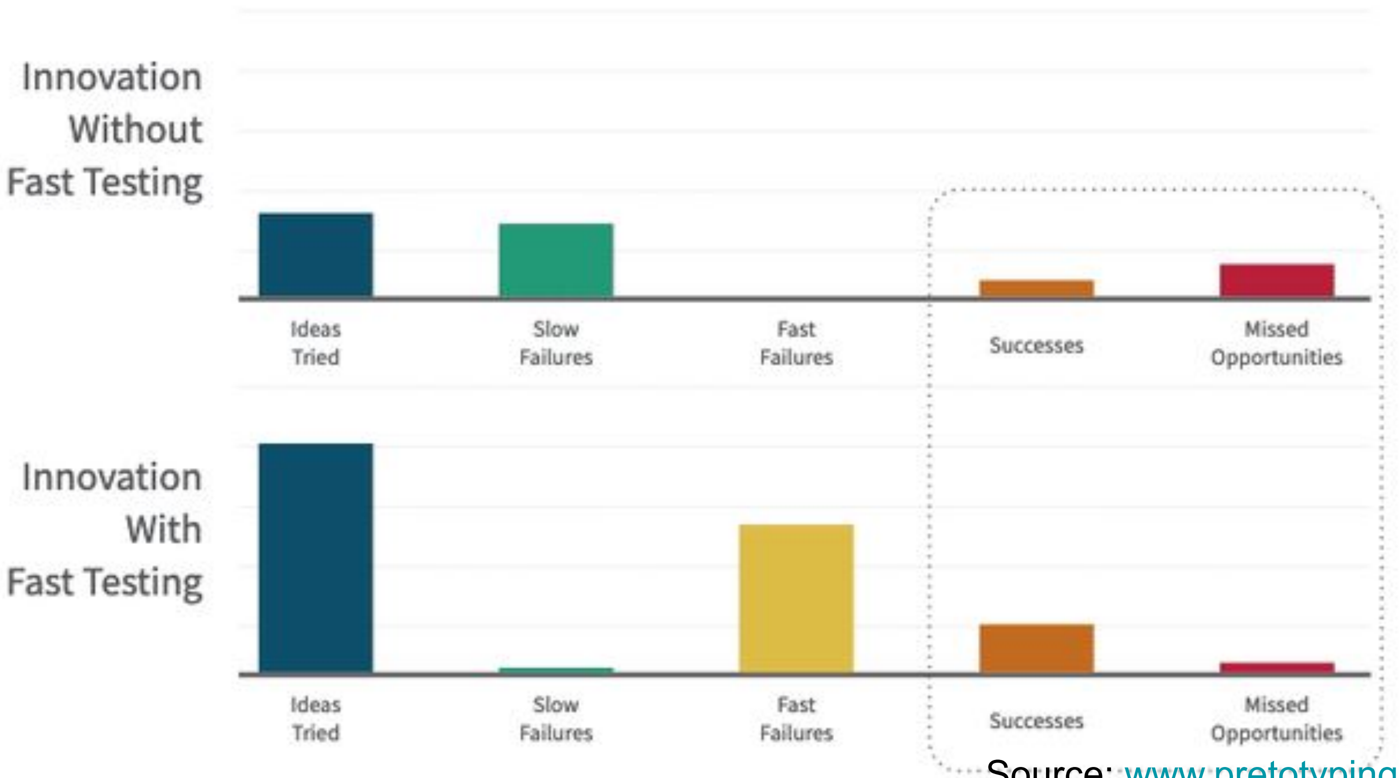
The law of market failure

There is only one way to fight the Law of Market Failure: **test the market** for your ideas objectively, rigorously, and **quickly before you invest to develop them.**

Pretotyping provides you with the tools and techniques you need to validate your idea with minimal resources and in a very short time (as little as a few hours.)

Source: www.pretotyping.org

The law of market failure in innvoation



Source: www.pretotyping.org

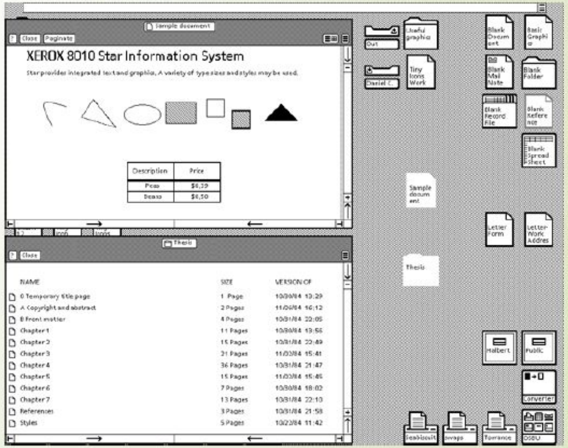
False Positive

- Webvan, late 90s
  - raised $122+M, Goldman Sachs, Sequoia Capital
  - Raised $375M in IPO, 1999
  - In total, raised over $1B
  - Bankruptcy July 2001
- Motorola's Iridium satellite phone system ($6B for 66 satellites)
- Segway (~$180M in funding)
- Google Wave real time messaging platform (~$20-30M)
- "John Carter" by Disney (Cost $275M + $100M in marketing)
- New Coke, Pepsi Clear (est. $50M).

Source: www.pretotyping.org

False Negative

- **SMS**
- **Twitter**
- **Google**
- **Xerox PARC**



Source: www.pretotyping.org

THOUGHTLAND

The Lost in Translation Problem: An idea is an abstraction–and a subjective one at that; it's something that you imagine or picture in *your* head. The moment you try to communicate what you see in your *mind's eye* to someone else you run into a challenging translation problem–especially if your idea is new and different from anything else they've seen. The way you imagine the new product and its uses may be completely different from the way *they* imagine it.

The Prediction Problem: Even if your audience's abstract understanding of your idea is a close match to your original intention, people are notoriously bad at predicting whether they would actually want or like something they have not yet experienced, or if and how they would actually use it.

Source: www.pretotyping.org

THOUGHTS WITHOUT DATA ARE JUST OPINIONS

False positives can lead you to believe that your idea is immune to The Law of Market Failure, so you invest too much too soon in a new product that will eventually flop. False negatives, on the other hand, can scare you away from giving your idea a chance, and you end up prematurely scrapping the next Twitter, or Google, or Tesla.

To minimize your chances of getting false positives or negatives you need to collect something more substantial and objective than opinions–especially when the people who give you those opinions have no skin in the game. And the only way to do that is to transport your idea from Thoughtland to a more concrete environment–let's call it *Actionland*.

In **Thoughtland** you use abstract **ideas** to ask hypothetical **questions** and collect **opinions**.

Thoughtland: Ideas -> Questions -> Opinions

In **Actionland** you use **artifacts** to prompt **actions** and collect **data**.

Actionland: Artifacts -> Actions -> Data

Source: www.pretotyping.org

The Pretotyping Manifesto

innovators beat ideas

pretotypes beat productypes

building beats talking

simplicity beats features

now beats later

commitment beats committees

data beats opinions

Source: www.pretotyping.org

Pretotyping Manifesto addendum:

don't finish what you've started

failure is an option

scarcity bring clarity

the more the messier

reinvent the wheel

play with fire

Source: www.pretotyping.org

Pretotype

Prototypes can help you fail faster, but often not fast enough or cheaply enough. The more you invest in something the harder it is to let it go and admit it was the wrong thing. Once you have a "proper prototype" working, it's tempting to work on it a little longer and invest in it a little more: "If we add this one feature I am sure that people will finally use it." Prototypes often turn into *productypes* – a prototype gone too far – and you can kiss fail-fast goodbye.

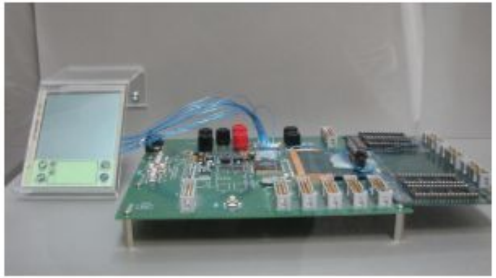
Source: www.pretotyping.org

Pretotype

Between abstract ideas and "proper prototypes" there are *pretotypes*. Pretotypes make it possible to collect valuable usage and market data to make a *go/no-go* decision on a new idea at a fraction of the cost of prototypes: hours or days instead of weeks or months, and pennies instead of dollars. Pretotyping helps you fail fast, recover fast and leaves you plenty of time, money, energy and enthusiasm to explore new tweaks or ideas until you hit on something that people seem to want – the rare and wonderful *right **it***!

Pretotype

Prototype



Product

Source: www.pretotyping.org

Pretotype

- **A pretotype is a mock-up of the intended product or service that can be built in minutes, hours or days instead of weeks, months or years.** The art and science of pretotyping is aimed to help innovators:
- Identify the core feature and *core experience* of the new potential product.
- Decide what core features can – and should – be mocked-up (or dramatically simplified).
- Use mock-ups to systematically test and collect feedback and usage data.
- Analyze usage data to determine the next step.

Source: www.pretotyping.org

The Seven Pillars of PRETOTYPING

1. Obey the Law of Market Failure.
2. Make sure you are building The Right It.
3. Don't get lost in Thoughtland.
4. Trust only in Your Own DAta (**YODA**).
5. Pretotype It.
6. Say it with numbers.
7. Think global, test local.

Source: www.pretotyping.org

PRETOTYPING FLOW

Step 1: Isolate the Key Assumption: *What is the one assumption about your idea that, if false, means it's definitely not the right it?*

Step 2: Choose a Type of Pretotype: What type of pretotype will let you to isolate and test your key assumption?

Step 3: Make a Market Engagement Hypothesis: How many (and what kind of) people will do what with your pretotype? Your hypothesis can be as simple as: X% of Y will do Z -->A solid hypothesis takes the guesswork and opinion out of testing. https://www.youtube.com/watch?v=4sZMHAMN0DQ&ab_channel=TheRightIt%E2%80%94VideolessonsbyAlbertoSavoia

Step 4: Test Your Pretotype: Now put your pretotype into the real world, and see how people interact with it. Start small — one place, one time.

Step 5:Learn, Refine, Hypozoom: Evaluate your results. Refine your pretotype with your new data. If you hypothesis held, decide what other situations you should test your pretotype in to get a complete picture (what we call "hypozooming"). https://www.albertosavoia.com/uploads/1/4/0/9/14099067/hypozooming_video.pdf
https://www.youtube.com/watch?v=bKfBbYsJlZc&ab_channel=TheRightIt%E2%80%94VideolessonsbyAlbertoSavoia

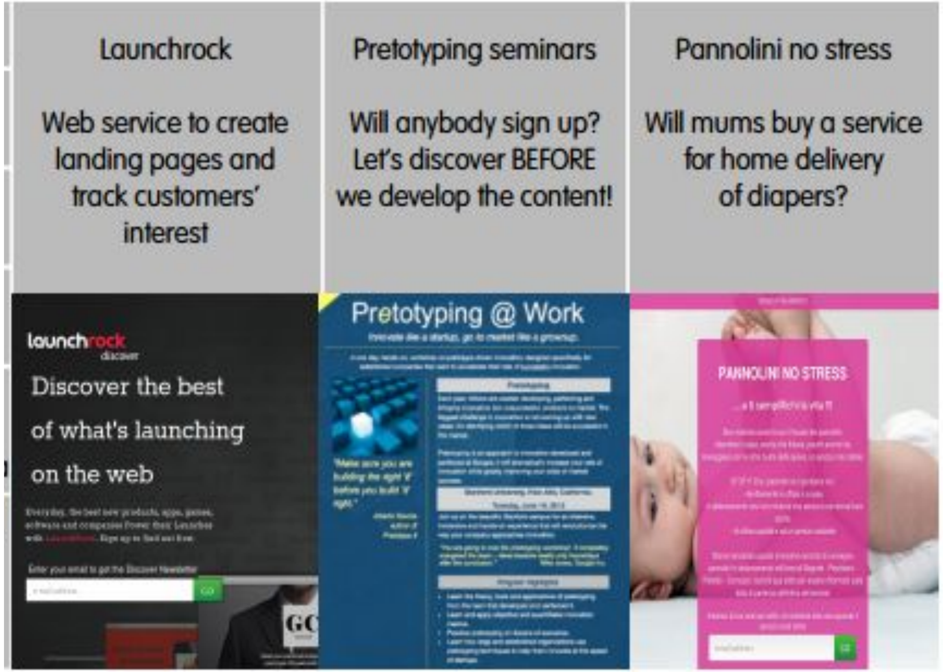
Source: www.pretotyping.org

FAKE DOOR

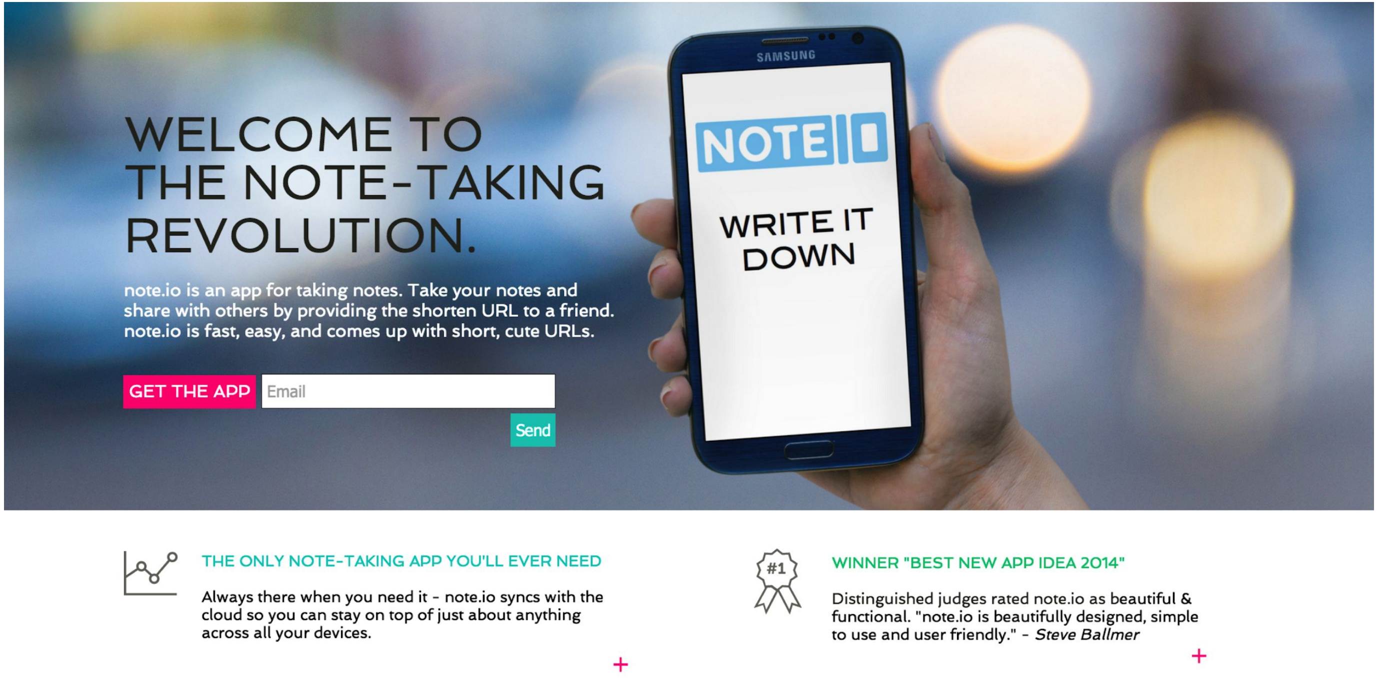
What	A marketing entry point for an as-yet undeveloped idea.
Why	The solution doesn't exist yet and you want to capture an initial indication of interest at next to 0 cost.
When	Your idea can be concisely described and presented to potential customers where you would expect to find them, and you are confident you can manage the expectations of enthusiastic customers by following up within an appropriate time-frame.
How	Advertising a new product or feature, then tracking click-through and customer response rate to see who would be interested in an offering.
Where	Web tech enables a very robust method that includes: online ads + landing pages + simple response forms. Same approach also works with emails, offline posters and other media.

the Fake Door can be used to advertise a service that is not ready yet and measure interest from users, e.g. a new process to renew a license, a new expert system to consolidate social services, etc.
https://www.nesta.org.uk/blog/development-and-testing-for-public-labs-fake-it-before-you-make-it/

FAKE DOOR



Source: www.pretotyping.org



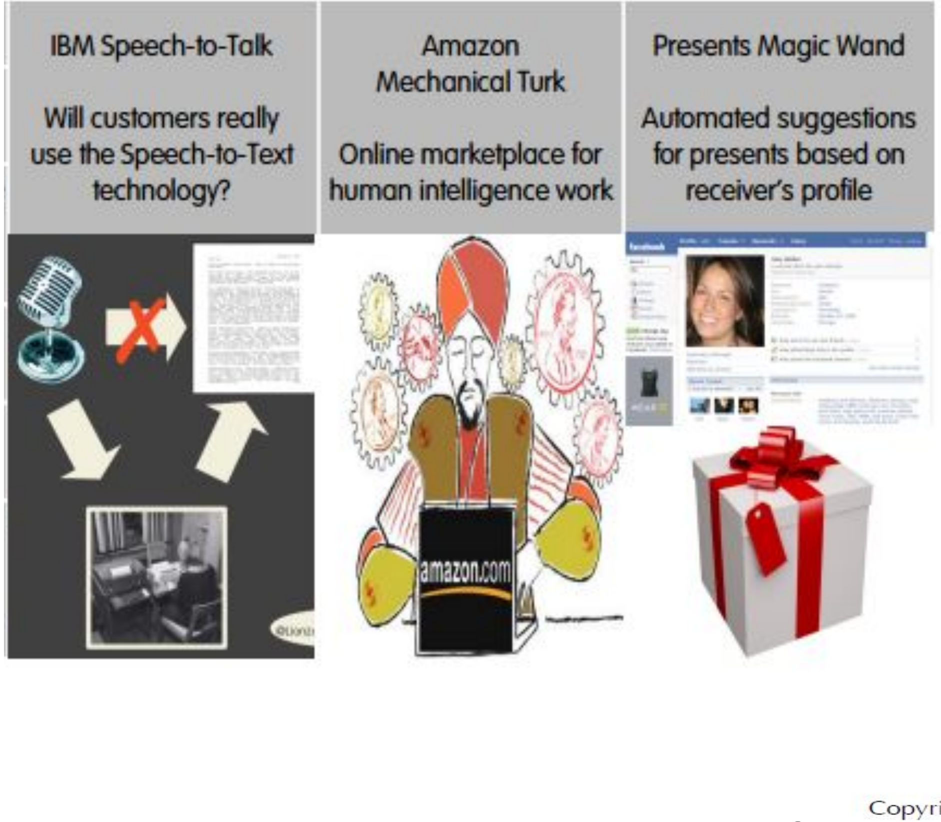
https://hackernoon.com/fake-door-the-mvp-before-the-mvp-61197ed264a3

MECHANICAL TURK

What	Use human power to simulate a technology that would take too much money or time to build
Why	To postpone costly development until market interest is validated.
When	When the final product requires the development of expensive and complex technology, and those actions and outputs could be simulated by humans.
How	Use a realistic interface to deliver target customers the essential experience of a proposed technology, simulating functionality of a complex back-end using human input.
Where	In the same real-life situation where the innovation will be used.

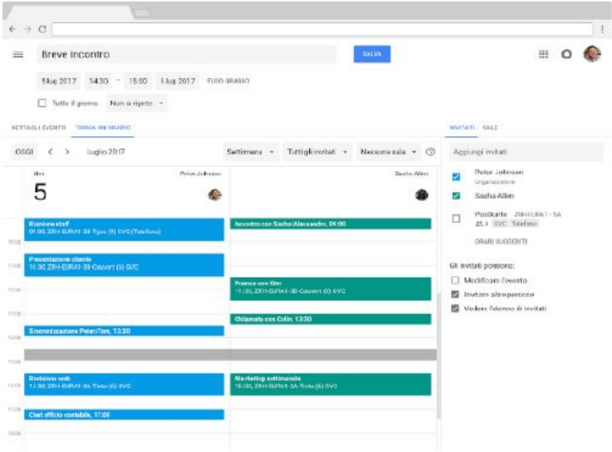
Algorithmic-based solutions are needed to reach scale while keeping the cost low. But before finding the right "advisor" to build, a Mechanical Turk approach can be used to experiment, where human experts can hide behind an online form or a SMS-based application.
https://www.nesta.org.uk/blog/development-and-testing-for-public-labs-fake-it-before-you-make-it/

MECHANICAL TURK

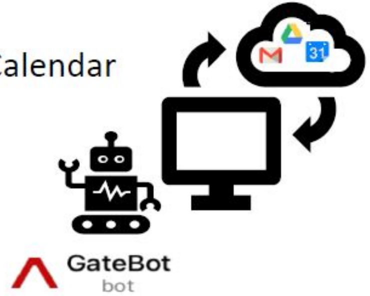


Source: www.pretotyping.org

Advanced schedule system



GateBot + G Suite Google Calendar



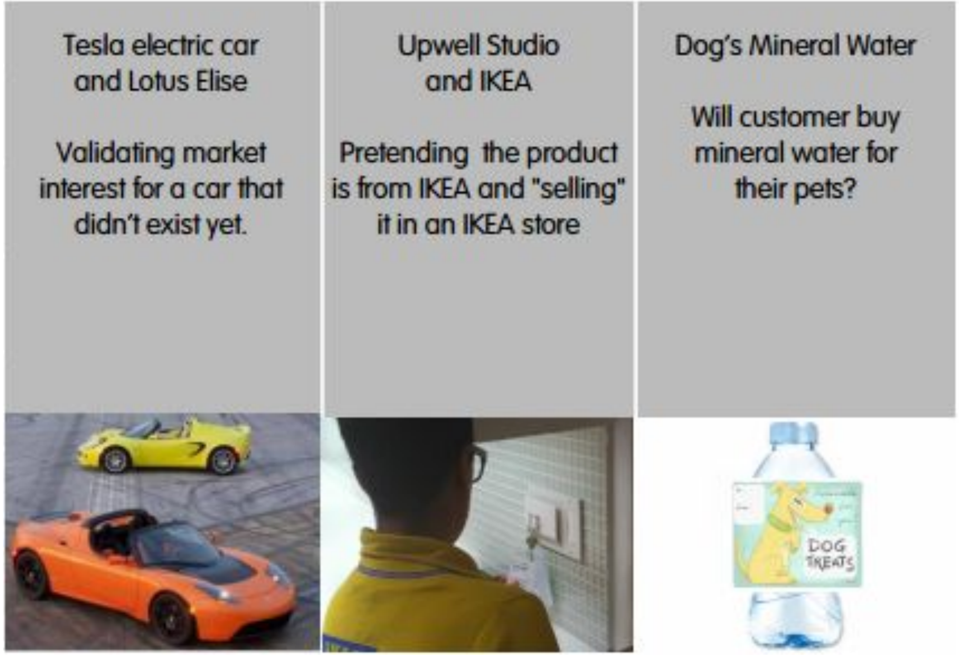
IMPERSONATOR

What	Use an existing product or service to pose as the new offer under test.
Why	Save on development costs while the market interest is not yet validated.
When	A test of the value of the solution depends on the customers' ability to interact with a full-scale design, and you need to create a plausible stand-in for the size, shape, color, features, etc. of the solution.
How	Apply a new skin to an existing product that can act as a good substitute to validate market interest.
Where	In the same real-life situation where the innovation will be used or accessed.

In the context of public labs, this could mean revamping an existing service by providing a different front-end on top of an existing API.
https://www.nesta.org.uk/blog/development-and-testing-for-public-labs-fake-it-before-you-make-it/

Video "IKEA" Design studio Upwell hacks IKEA... on Vimeo

IMPERSONATOR



https://vimeo.com/79313674

Source: www.pretotyping.org

PINOCCHIO

What	An inanimate (or "dumb") artifact acts as a proxy for the real thing.
Why	The solution doesn't exist yet and you want to validate a key design parameter early on.
When	Your solution requires a significant switching or behavioral adaptation by customers to develop a new habit OR You expect demand to be sensitive to the appearance or form factor of your solution.
How	Use a proxy to validate certain parameters of the product like form factor, features and usability.
Where	In the same real-life situation where the innovation will be used.

A Pinocchio pretotype is one in which a fake artifact acts as a proxy for the real thing. The most famous example is the wood model of the Palm Pilot mentioned above.

Pinocchio pretotypes are the perfect conduit for role play design to encourage people to test your product or service, but also to explore other ways that the "it" you are building is tailored to their needs.

PINOCCHIO

Source: www.pretotyping.org

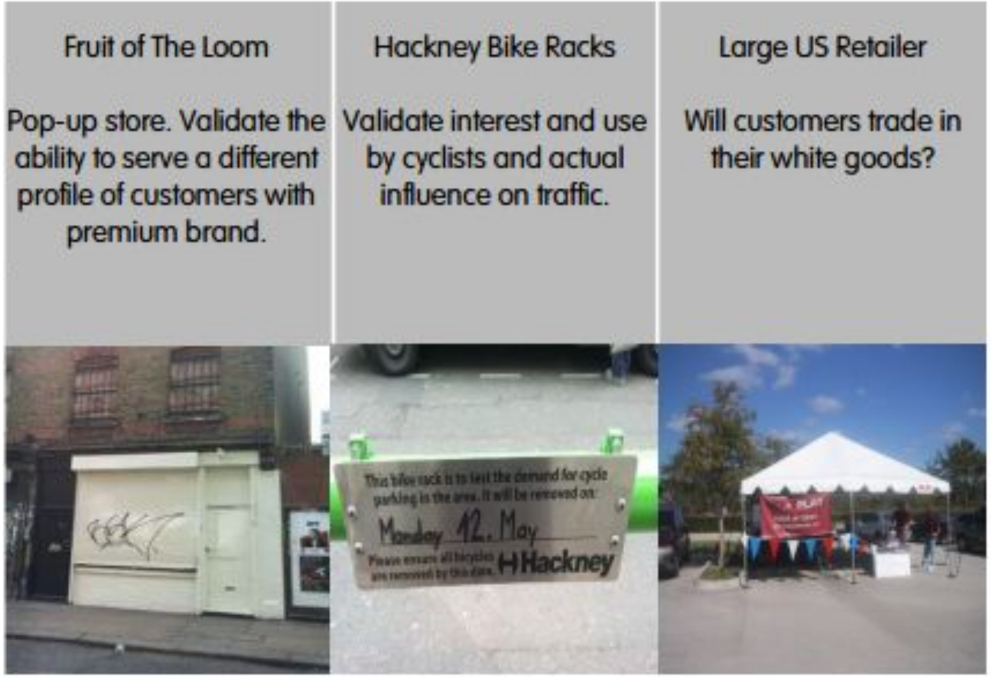
ONE NIGHT STAND

What	A complete service experience without the infrastructure required by a permanent solution.
Why	Avoid investment in complex infrastructure and validate market interest and actual use.
When	- The solution is — or depends critically upon — an interactive service experience. - You expect demand for the offer will be sensitive to the choice of channel, and you need to test a number of possible customer interception points. - You want to validate a large homogeneous market before scaling up.
How	Delivering target customers the essential experience within an extremely narrow geo scope and time frame.
Where	In the same real-life situation where the innovation will be used but with limited time and geo scope.

The goal here is to reduce cost or to target a well-known population. In the spirit of failing fast, if the One Night Stand pretotype applied to a friendly region and receptive population does not succeed, then you know that you are probably building the wrong "it".

https://www.nesta.org.uk/blog/development-and-testing-for-public-labs-fake-it-before-you-make-it/

ONE NIGHT STAND



Source: www.pretotyping.org

FACADE

What Borrow or rent expensive equipment, space, and assets to simulate a more stable or complex infrastructure underlying your offering.

Why Avoid investments in expensive equipment, space, and other assets while validating interest.

When - The solution requires major upfront investment, in equipment, space, or assets.
- You expect demand will vary based on customer confidence in your infrastructure.

How Delivering target customers the essential experience, while communicating stability and complexity.

Where In the same real-life situation where the innovation will be used, but with all assets and space borrowed or rented cheaply.

https://www.youtube.com/watch?v=9ko6oFb-jQY

NEXT STEP… PRODUCTION?

MINIMUM VIABLE PRODUCT

MINIMUM VIABLE PRODUCT

WHAT	The transition from pretotyping to prototyping of the eventual product
HOW	Creating an artifact which delivers the core function(s) of the full solution
WHY	you need to put the real product into customers' hands in order to permit a fair test
WHERE	In the same real-life situation where the innovation will be used
WHEN	You have learned all you can about market demand from simpler pretotypes (Fake Door, Pinocchio, Mechanical Turk, One Night Stand, or Impersonator) and further insight requires a deeper customer interaction with a functioning artifact

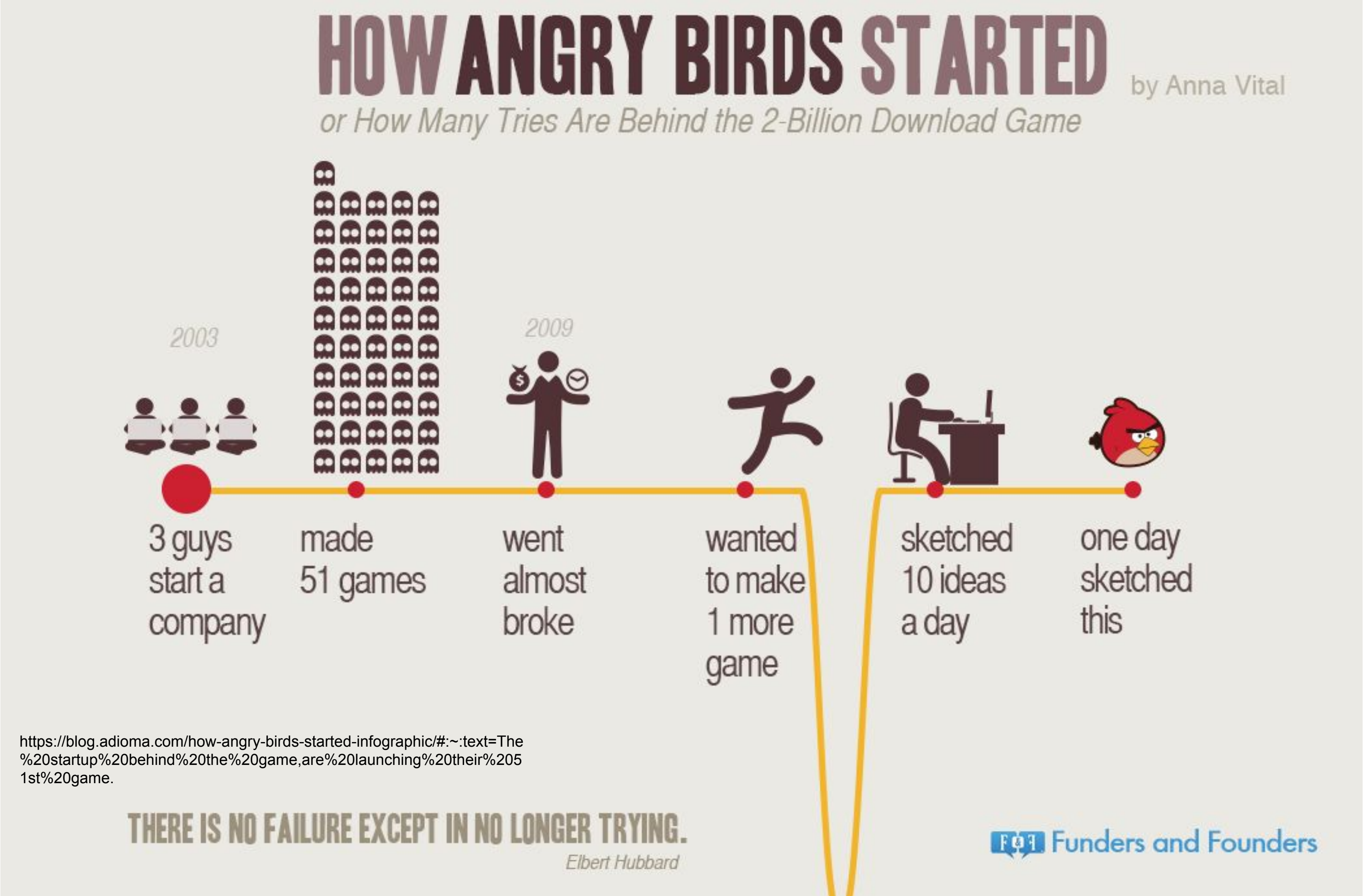
Pretotype it book	An IPod Battery Pack	The Treadmill Bike
Is there an audience for this content?	Is it handy to use one?	How is it like to run on a treadmill to propel a bike????

Source: www.pretotyping.org

Source: www.pretotyping.org

Pretotyping tools

- WebsiteWeebly.com: Particularly useful for fake door pretotypes to test using Google/Facebook ads.
- Omnigraffle: Shares across multiple pages and spits out clickable
- Appery - free, cloud-based app platform - http://appery.io
- UX prototype https://www.figma.com/
- https://careerfoundry.com/en/blog/ux-design/prototyping-tools/
- And even more drag and drop app builders:
  - https://codiqa.com/
  - http://www.kinvey.com/
  - http://cloudbase.io/
  - http://mobile.conduit.com/
  - http://mobileroadie.com/
  - http://www.theappbuilder.com/
- Marketplace builder https://www.shopify.com/



https://blog.adioma.com/how-angry-birds-started-infographic/#:~:text=The%20startup%20behind%20the%20game,are%20launching%20their%2051st%20game.

Alberto Savoia Pretotyping Lecture @ Stanford

https://www.youtube.com/watch?v=3sUozPcH4fY&feature=emb_logo

UX for connected devices

UX for connected devices

When we think of design for connected products, we tend to focus on the most visible and tangible elements:

- the industrial design
- the user interfaces (UIs) found in mobile and web apps and on the devices themselves.

They are important concerns, which have a major impact on the end user's experience of the product. But they're only part of the picture.

You could create a beautiful UI, and a stunning piece of hardware, **and users could still have a poor experience of the product as a whole.**

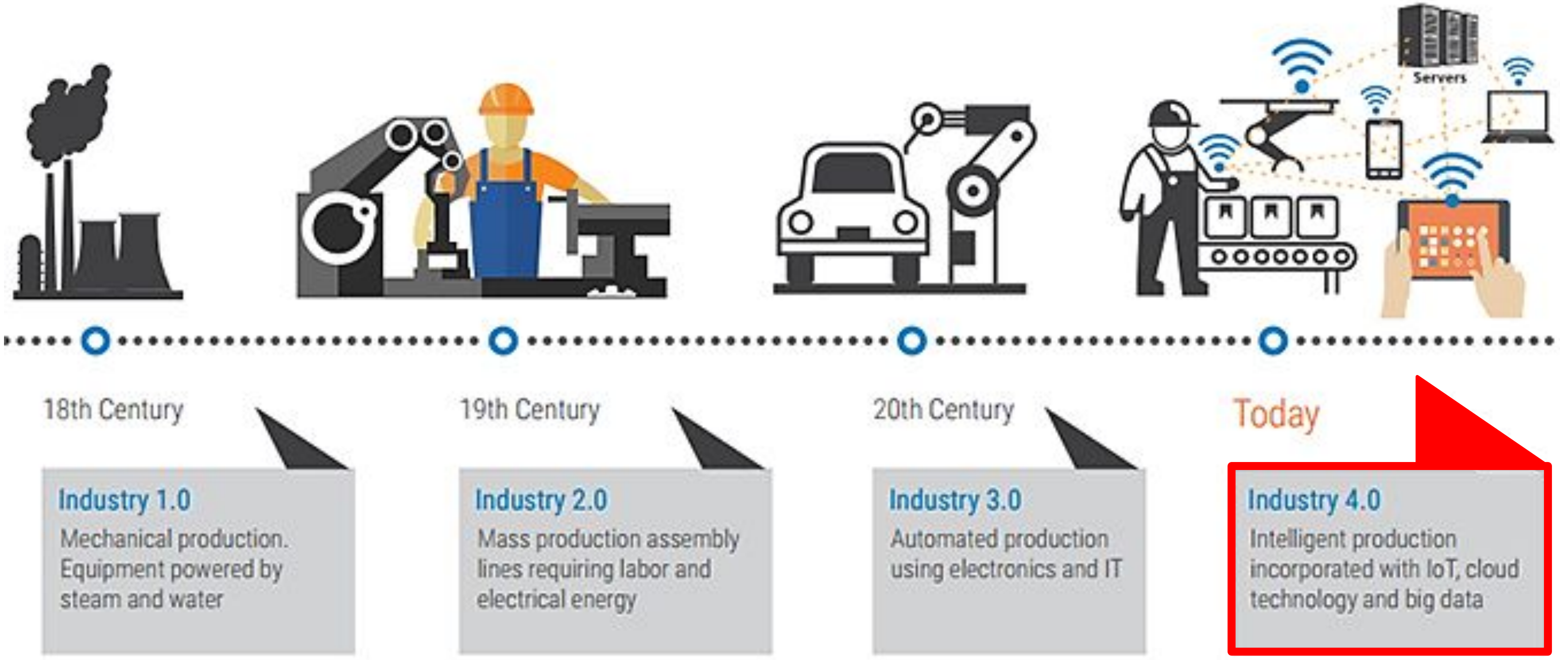
INTERNET

Internet[1] è una rete ad accesso pubblico che connette vari dispositivi o terminali in tutto il mondo. Dalla sua nascita rappresenta il principale mezzo di comunicazione di massa,[2][3][4] che offre all'utente una vasta serie di contenuti potenzialmente informativi e di servizi.

The Internet of Things

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people **that are provided with unique identifiers (UIDs) and the ability to transfer data over a network** without requiring human-to-human or human-to-computer interaction

THE INDUSTRY 4.0

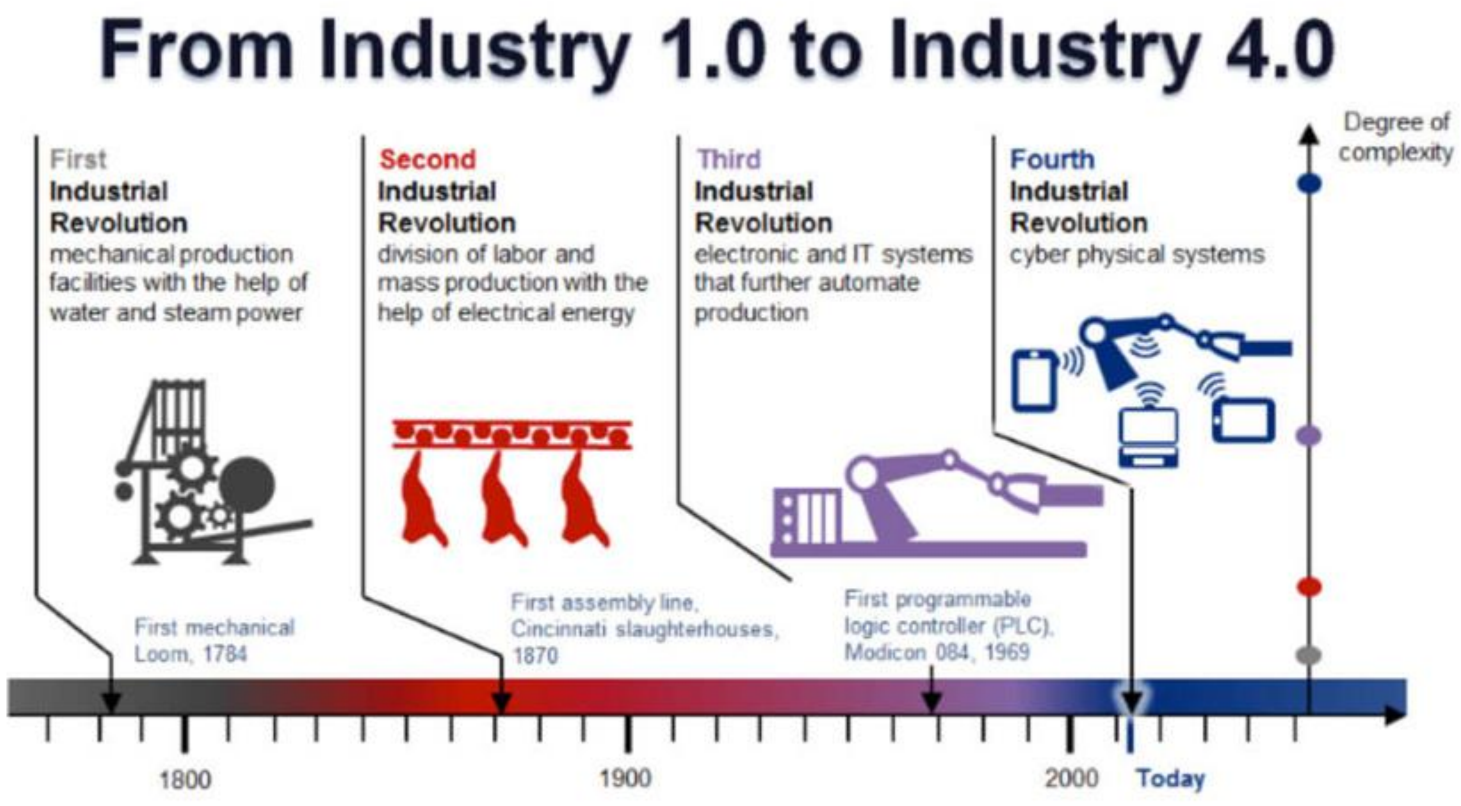


THE INDUSTRY 4.0

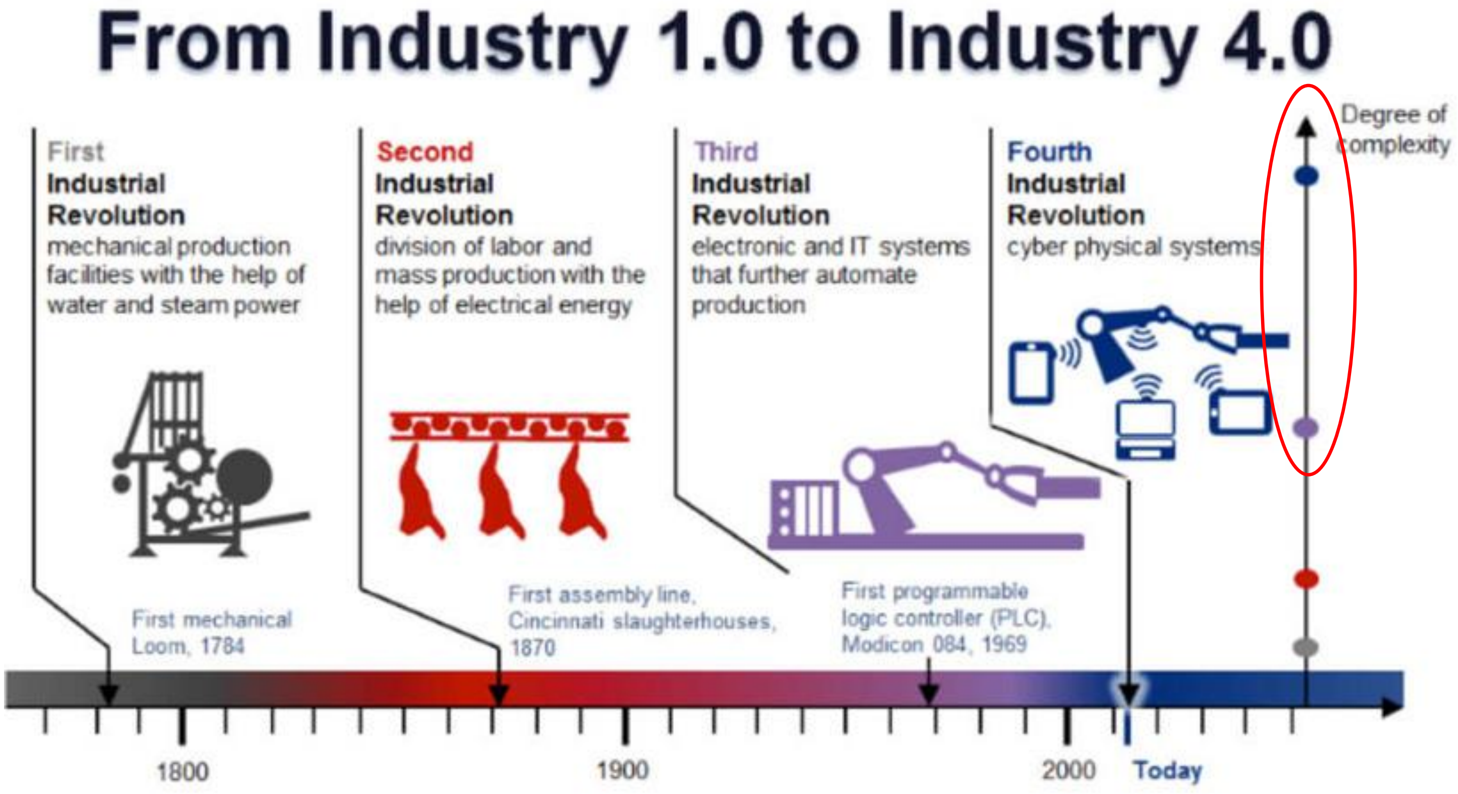
- Industry 4.0 describes the ***organisation of production processes*** *based on* ***technology and devices autonomously communicating with each other along the value chain****:* a model of the ‘smart’ factory of the future where computer-driven **systems monitor physical processes, create a virtual copy of the physical world** and make decentralised decisions based on self-organisation mechanisms. The concept takes account of the increased digitalisation of manufacturing industries where **physical objects are seamlessly integrated into the information network**, allowing for decentralised production and real-time adaptation in the future.
- Industry 4.0 was initially developed by the German government to create a coherent policy framework to maintain Germany’s industrial competitiveness.

From: Industry 4.0 Study for the ITRE Committee - *www.europarl.europa.eu/RegData/etudes/STUD/.../IPOL_STU(2016)570007_EN.pdf*

THE INDUSTRY 4.0



THE INDUSTRY 4.0



INDUSTRY 4.0

The Industrial Internet of Things has been heralded primarily as a way to improve operational efficiency. But in today's environment, companies can also benefit greatly by seeing it as a tool for finding growth in unexpected opportunities.

In the future, successful companies will use the Industrial Internet of Things to capture new growth through three approaches: boost revenues by increasing production and creating new hybrid business models, exploit intelligent technologies to fuel innovation, and transform their workforce.

https://www.accenture.com/us-en/_acnmedia/Accenture/next-gen/reassembling-industry/pdf/Accenture-Driving-Unconventional-Growth-through-IIoT.pdf

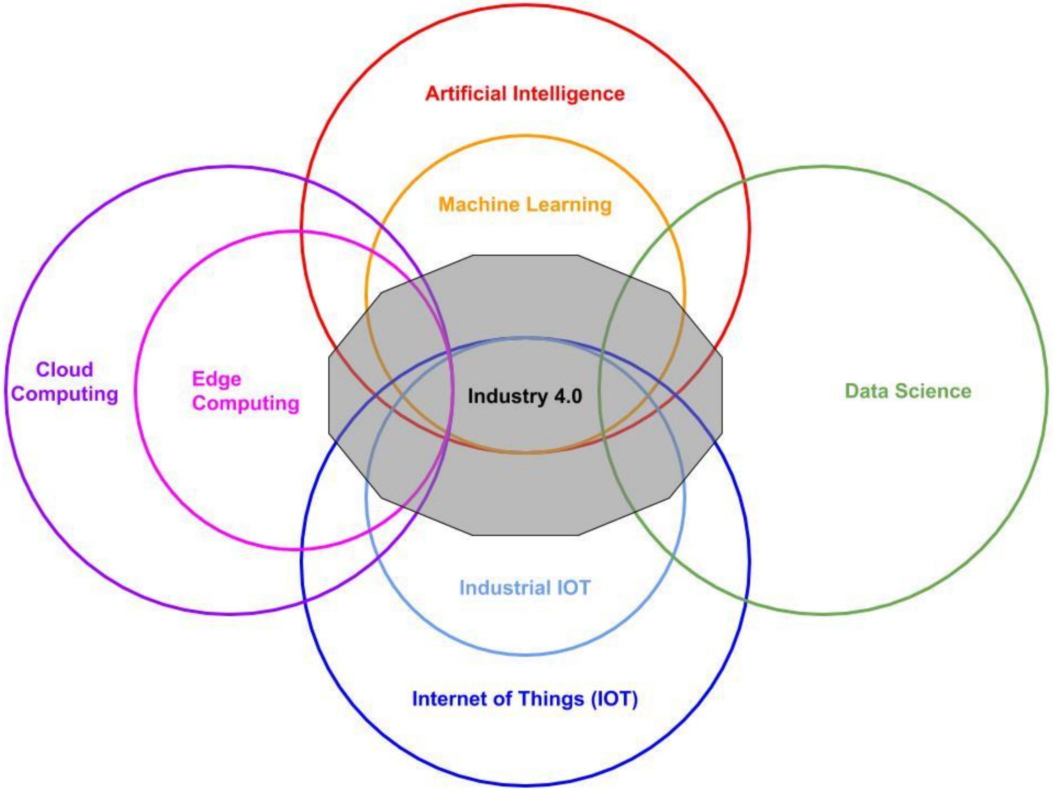
By Paul Daugherty, Prith Banerjee, Walid Negm and Allan E. Alter

DIGITAL TWIN

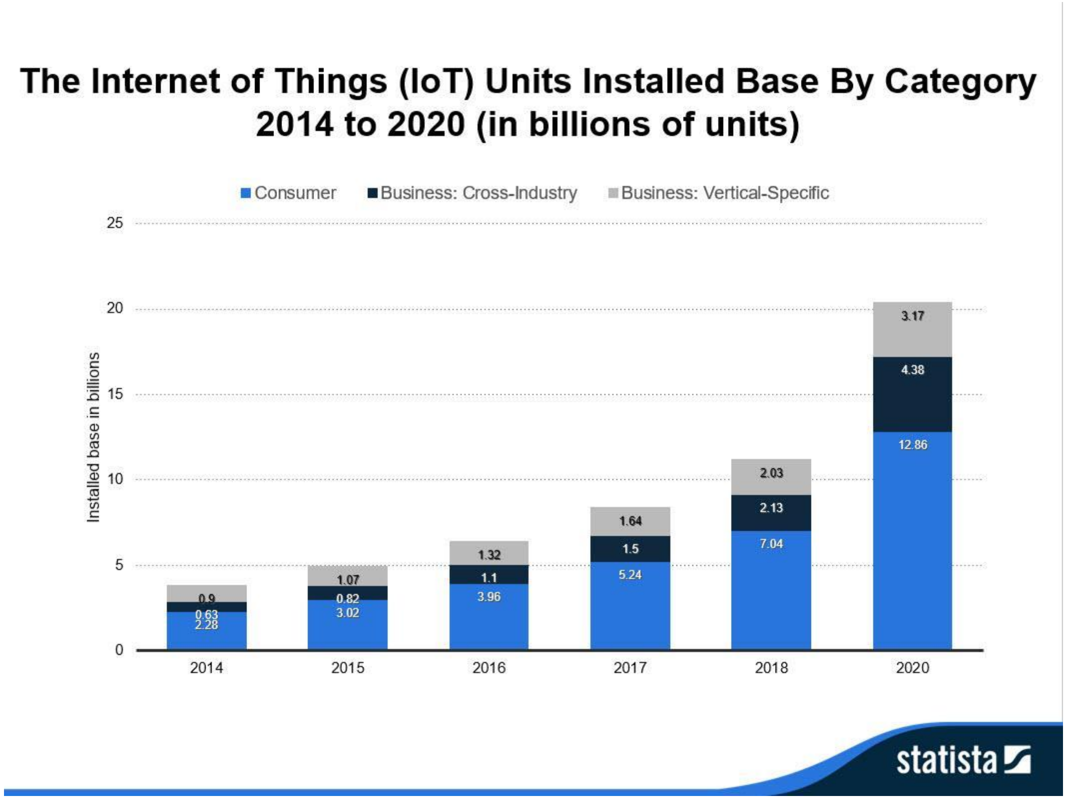
A digital twin is a digital replica of a physical entity.

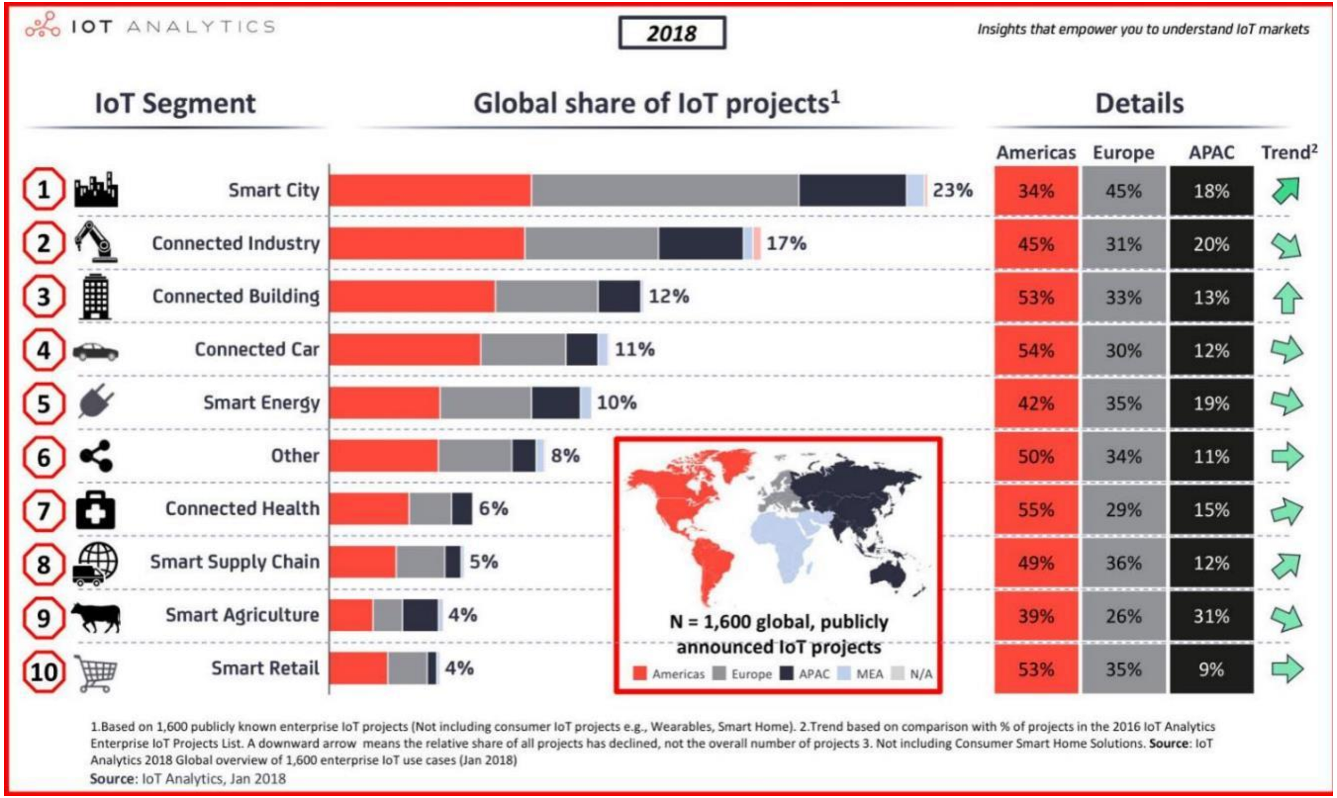
By bridging the physical and the virtual world, data is transmitted seamlessly allowing the virtual entity to exist simultaneously with the physical entity.

Digital twin refers to a digital replica of physical assets, processes, people, places, systems and devices that can be used for various purposes.

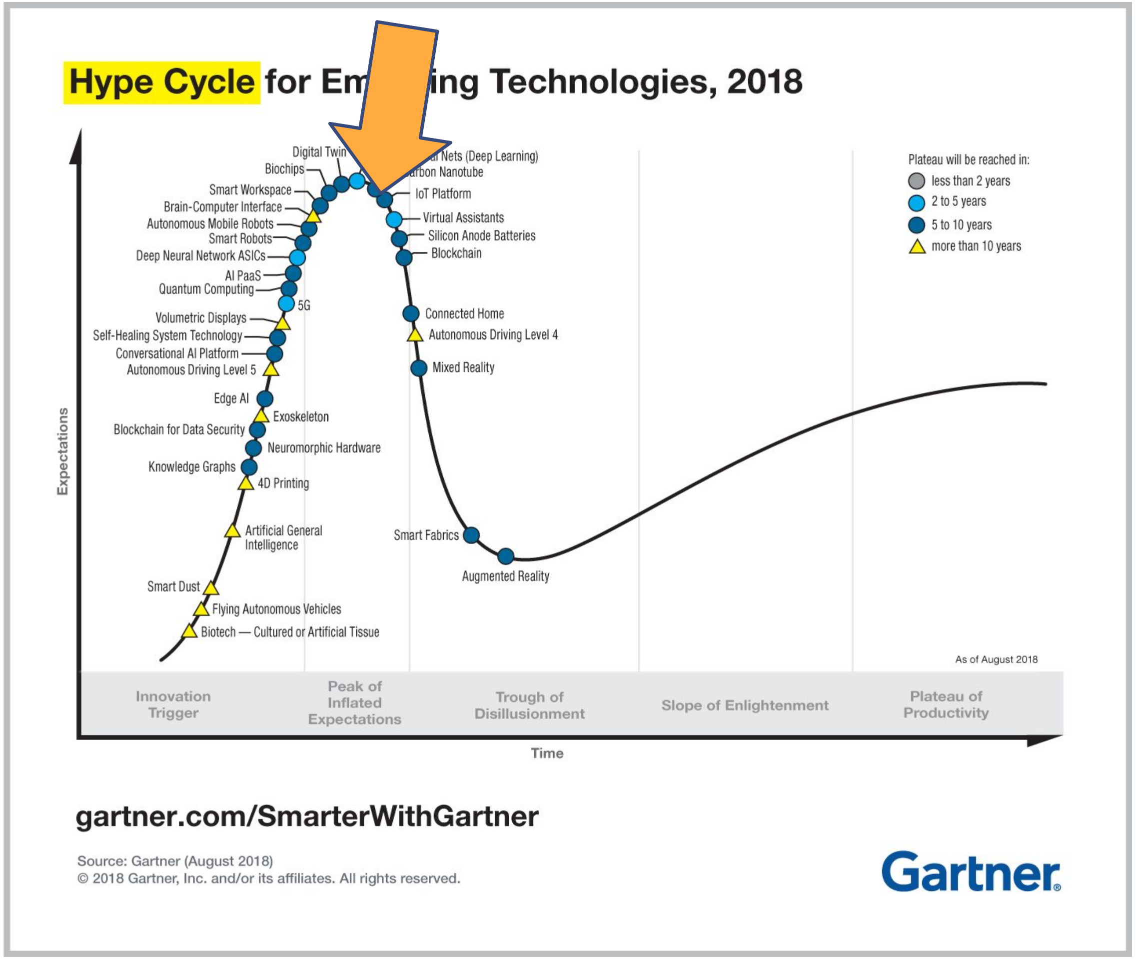


4.0 HOLISTIC VISION


The Internet of Things (IoT) Units Installed Base By Category 2014 to 2020 (in billions of units)
Consumer
Business: Cross-Industry
Business: Vertical-Specific
Installed base in billions
25
20
15
10
5
0
0.9
0.63
2.28
1.07
0.82
3.02
1.32
1.1
3.96
1.64
1.5
5.24
2.03
2.13
7.04
3.17
4.38
12.86
2014
2015
2016
2017
2018
2020
statista



https://www.forbes.com/sites/louiscolumbus/2018/06/06/10-charts-that-will-challenge-your-perspective-of-iots-growth/#ce3f6623ecce


Hype Cycle for Em
ing Technologies, 2018
Expectations
Digital Twin
Biochips
Smart Workspace
Brain-Computer Interface
Autonomous Mobile Robots
Smart Robots
Deep Neural Network ASICs
AI PaaS
Quantum Computing
5G
Volumetric Displays
Self-Healing System Technology
Conversational AI Platform
Autonomous Driving Level 5
Edge AI
Exoskeleton
Blockchain for Data Security
Neuromorphic Hardware
Knowledge Graphs
4D Printing
Artificial General Intelligence
Smart Dust
Flying Autonomous Vehicles
Biotech — Cultured or Artificial Tissue
Nets (Deep Learning)
IoT Platform
Virtual Assistants
Silicon Anode Batteries
Blockchain
Connected Home
Autonomous Driving Level 4
Mixed Reality
Smart Fabrics
Augmented Reality
Plateau will be reached in:
less than 2 years
2 to 5 years
5 to 10 years
more than 10 years
As of August 2018
Innovation Trigger
Peak of Inflated Expectations
Trough of Disillusionment
Slope of Enlightenment
Plateau of Productivity
Time
gartner.com/SmarterWithGartner
Source: Gartner (August 2018)
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Gartner

THE INTERNET OF THINGS

The **Internet of things** (**IoT**) is the network of devices such as vehicles, and home appliances that contain electronics, software, sensors, actuators, and connectivity which allows these things to connect, interact and exchange data.[1][2][3][4]

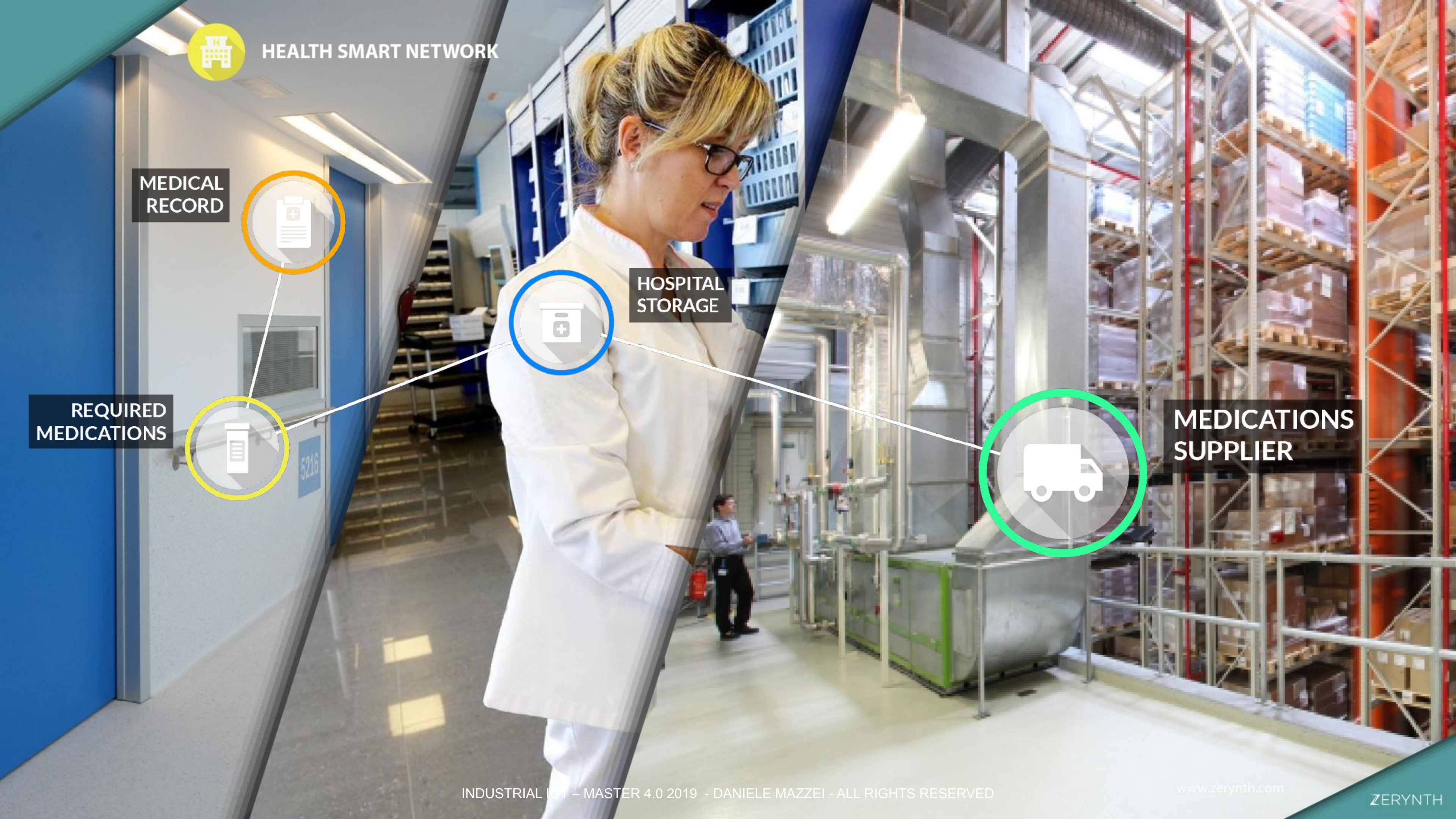
IOT IS JUST AN ENABLING TECHNOLOGY!

PRODUCTS AND SERVICES IN THE 4.0 ERA

UBIQUITOUS TECHNOLOGY AND BIG DATA

4.0 SMART PRODUCTS AND SERVICES

A smart product is a physical device with a digital service at its heart


HEALTH SMART NETWORK
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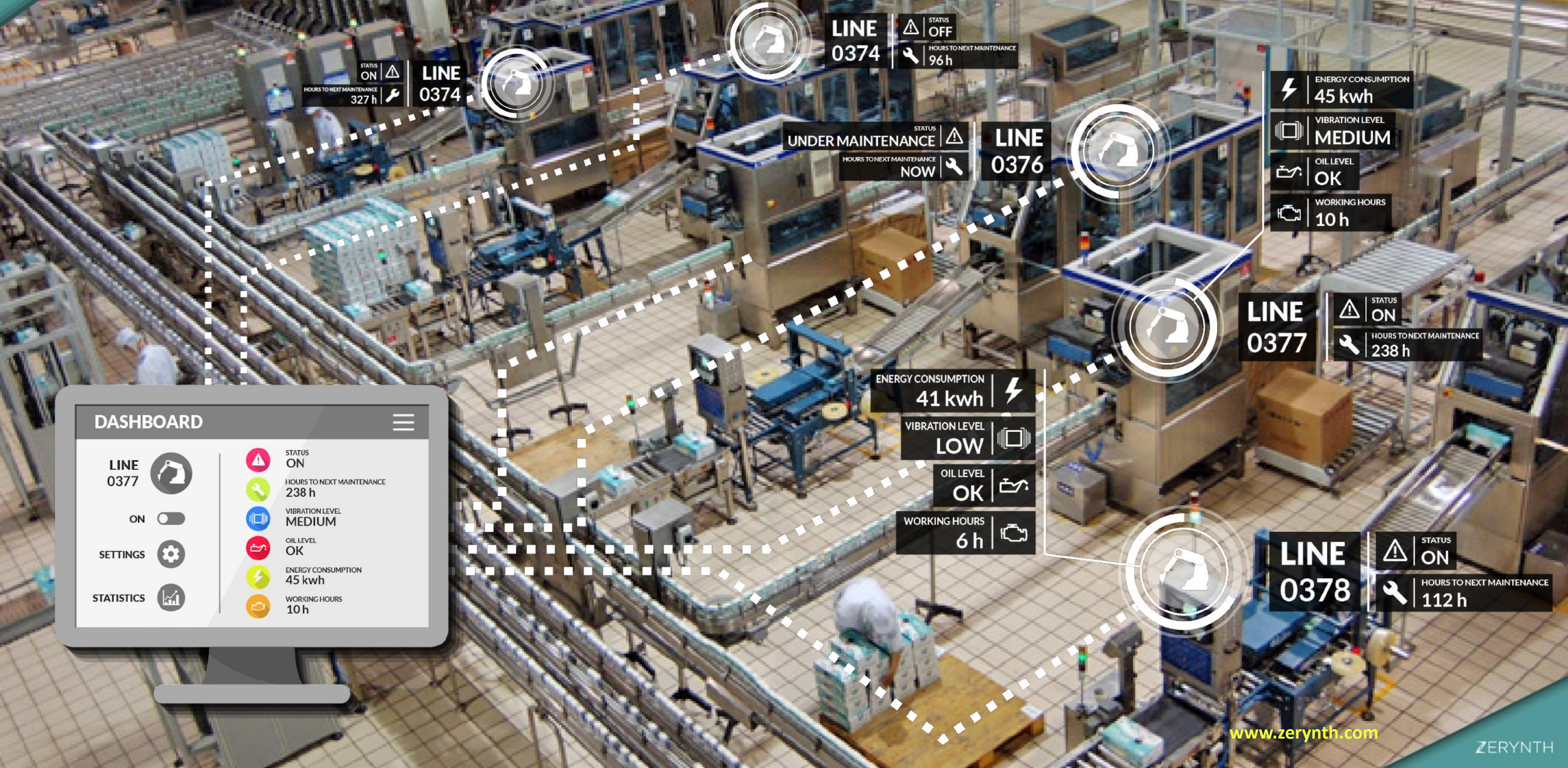
FACTORY ON INTERNET



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WELLS ON INTERNET

NEW DESIGN PRINCIPLES

UX for IOT

Designing for the IoT **is inherently more complex than web service design.**

Some of this is to do with the current state of the technology.

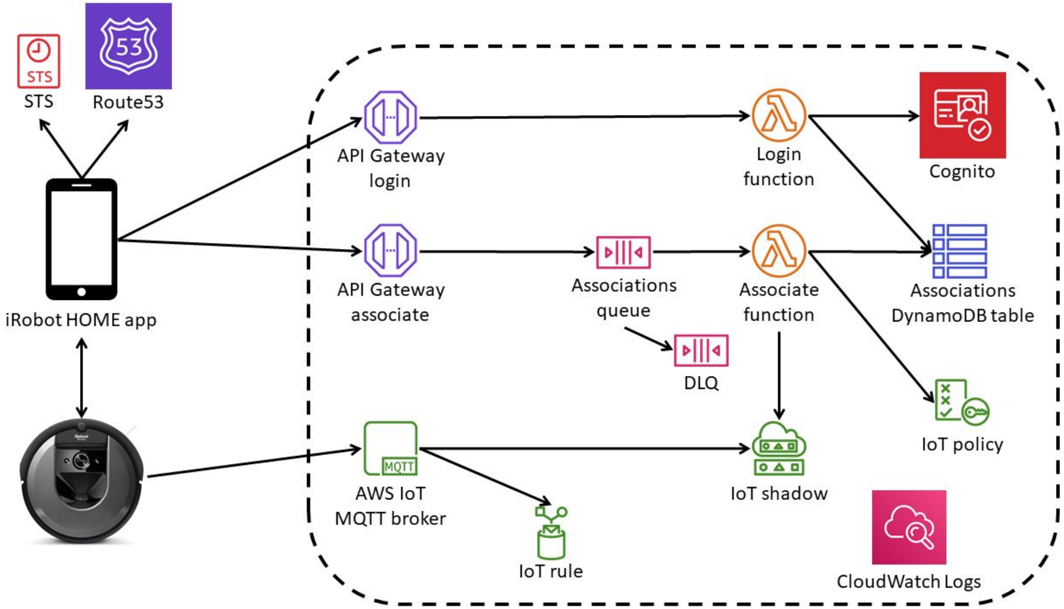
Some of this reflects our as-yet immature understanding of compelling consumer IoT value propositions.

Some of this stems from the fact that there are more aspects of design to consider. **Tackling them independently creates an incoherent user experience (UX).**

UX for IOT

Designing a great connected product requires a holistic approach to user experience.

It spans many layers of design, not all of them immediately visible.



https://aws.amazon.com/solutions/case-studies/irobot-iot/

Why UX for IOT is different?

Connected products pose design challenges that will be new to designers accustomed to pure software services.

Many of these challenges stem from:

- The specialized nature of IoT devices
- Their ability to bridge the digital and physical worlds
- The fact that many IoT products are distributed systems of multiple devices
- The quirks of networking

Specialized Devices, with Different Capabilities

Many of the “things” in the Internet of Things are **specialized, embedded computing devices.** Unlike general-purpose computers (smartphones and PCs), their **hardware and software is optimized to fulfill specific functions.**

Their **physical forms must be designed** and engineered.

Their **UI capabilities may extend from screens and buttons into physical controls**, audio, haptics, gestures, tangible interactions, and more.

But **user interactions must be designed without the benefit of the style guides and standards** that web and mobile designers can rely upon.

Some may have no user input or output capabilities at all. The only way to find out what they are doing or what state they are in may be via a remote UI.

Real-World Context

Connected products exist in the physical world.

Sensors enable us to capture data we did not have before for digital transmission, allowing us to take more informed actions in the real world.

Actuators provide the capability for digital commands to produce real-world effects.

They can be remotely controlled, or automated. But unlike digital commands, real-world actions often cannot be undone.

https://www.oreilly.c

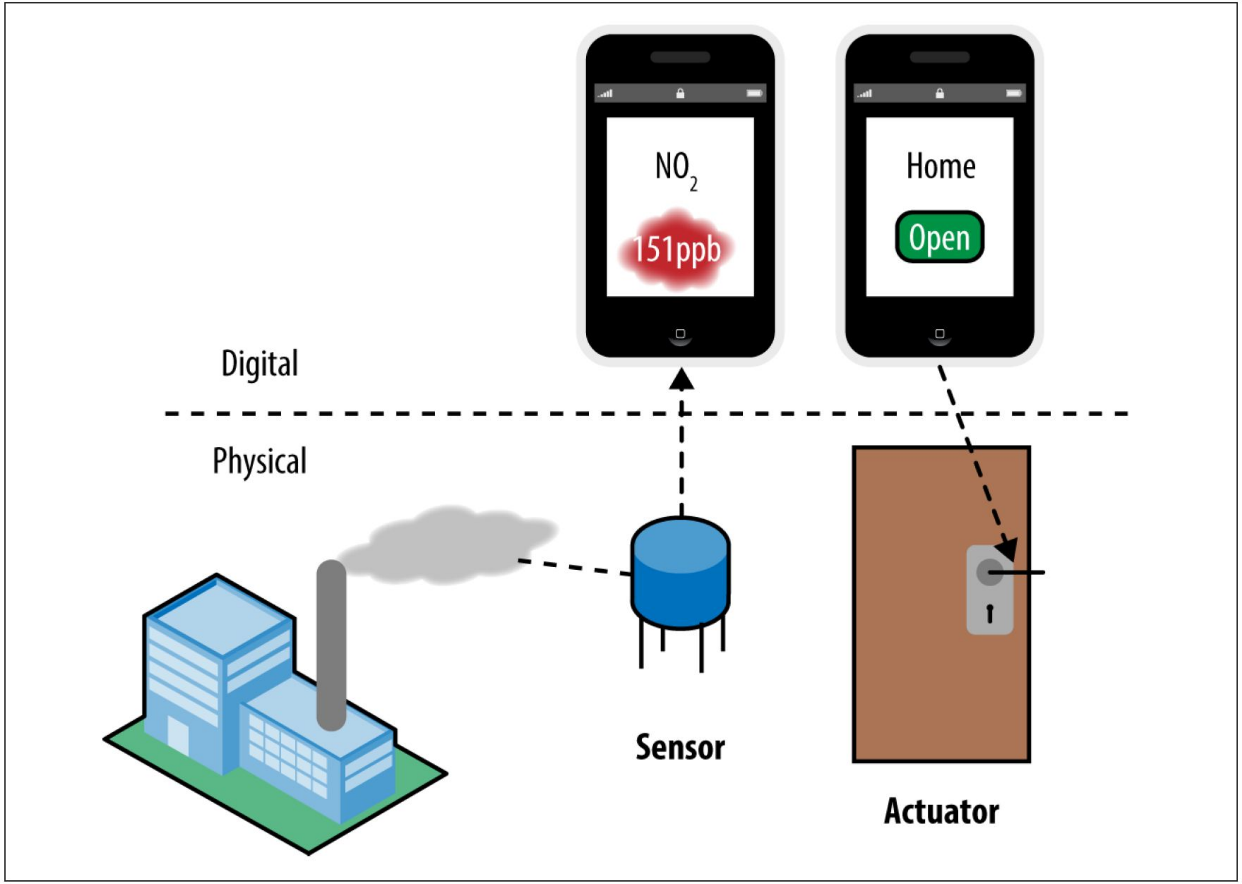


Figure 1-2. Sensors convert readings from the physical environment into digital information; actuators convert digital instructions into mechanical actions.

Real-World Context

The physical context of use creates further challenges.

Devices may need to be ruggedized for outdoor use.

An in-car system needs to be designed to minimize distraction while driving.

A remotely controlled oven needs to minimize the risk of fire.

Devices must adhere to regulatory requirements such as radio interference or waste recycling standards.

And the social context of use may be particularly complex, especially in the home.

Techno-centric solutions which are insensitive to the needs of the occupants will fail. For example, an assisted living product needs to balance the need of vulnerable people

Designing for Systems of Devices and Services

Many connected products are systems of diverse devices and services.

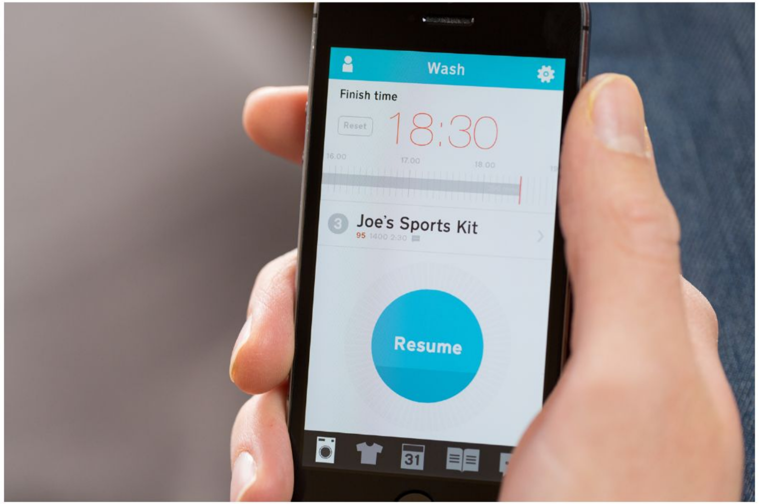
Functionality may be distributed across multiple devices with different capabilities.

Designers need to **consider how best to distribute functionality** across devices.

They need to **design UIs and interactions across the system as a whole** — not treating devices as standalone UIs — to ensure that the overall UX is coherent.

This is **interusability.** Much of the information processing for an IoT product will often happen in the Internet service. So the whole system experience is often equally or more important than any single device UX.


Wash
Delay
Start / Stop
BERG
Notify
Conditioner
Detergent


Wash
Finish time
Reset
18:30
Joe's Sports Kit
Resume

DAN

erved)

Designing for Systems of Devices and Services

Furthermore, they need some understanding of how the system works.

Even quite simple connected products are conceptually more complex than non-connected ones.

Code can run in more places. Parts of the system will inevitably go offline from time to time.

When this happens, basic knowledge of which component does what will help users understand the consequences, and figure out what action may be required.

Designing for Systems of Devices and Services

In this context, the designers and engineers of connected products should do their best to create **a unified environment for the IoT system**.

In other words, the challenge of a seamless experience is to **integrate diverse independent components into a one-stop solution** while saving its functionality and reliability.

Direct vs remote configuration

Over the last 30 years, the prevailing trend in UI design has been direct manipulation.

Users control visual representations of objects and immediately see the outcome of their actions (which can be reversed)

But many IoT interactions are displaced in location (remote control) or time (automation). This breaks the link between user actions and visible, reversible consequences!

Design for Networks

Another major factor is the impact of the network on UX.

Designers from web and mobile software backgrounds have the luxury of assuming that devices will be nearly always connected.

In IOT this is not true anymore!

Design for network

Our experience of the physical world is that things respond to us immediately and reliably.

Light switches do not “lose” our instructions or take 30 seconds to produce an effect.

Delays and glitches are inherent properties of physical networks and transmission protocols.

But they may feel strange experienced through “real-world” things. It’s impossible to engineer these issues entirely out of any Internet-connected system.

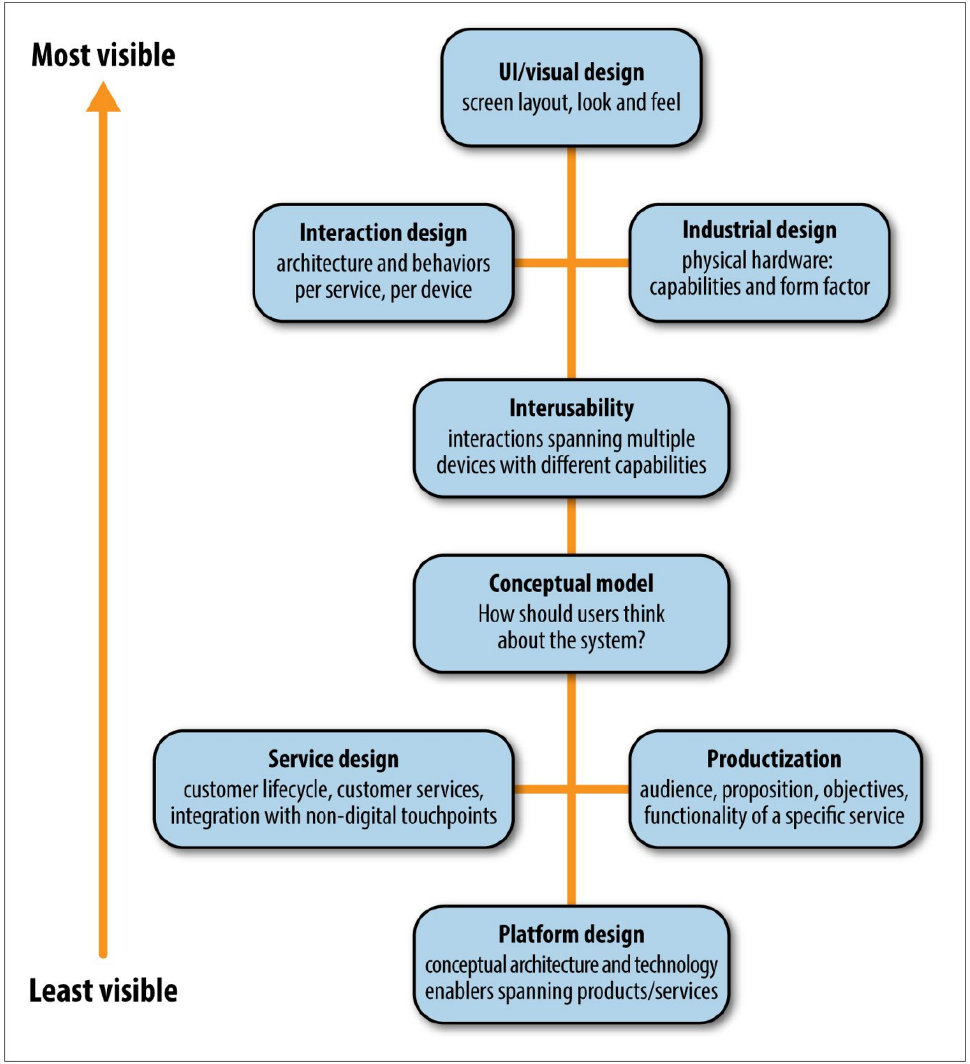
Design for power saving

In addition, the nature of connected devices is that they often connect only intermittently, in order to conserve power.

Computers promise to provide us with precise, accurate, and timely data about the world around us.

But distributed IoT systems may not always be in sync, and different devices may therefore report different information about the state of the system.

UX for IOT flow and architeture



UX for IOT flow and architeture

A good overall product requires integrated thinking across all these layers.

A stunning UI means nothing if your product concept makes no sense.

A beautiful industrial design may sell products in the short term, but can’t mask terrible service.

