

# Design Considerations

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# Outline

Design Cycle

Output Diversity

Multithread / Shared Control

Apprenticeship

Learning Curve

Efficiency

# Outline

Design Cycle

Output Diversity

Multithread / Shared Control

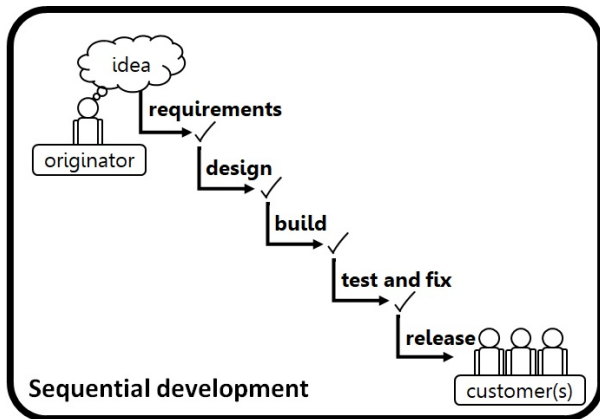
Apprenticeship

Learning Curve

Efficiency

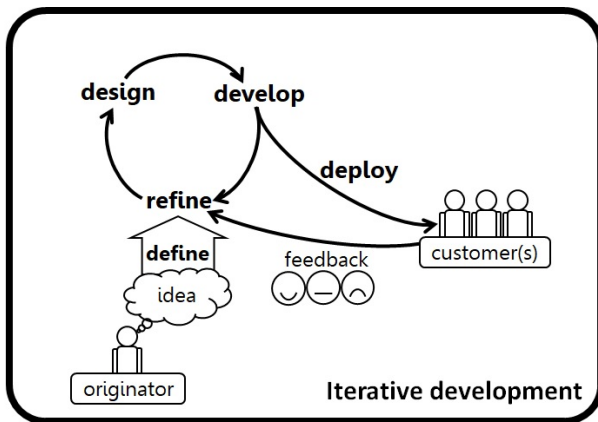
# Design Cycle

## Waterfall Model



# Design Cycle

## Iterative Model



Questions about the Iterative Model:

- ▶ How to evaluate? (again)
- ▶ Who are the "customers"?

Who are the "customers"?

"New standards may not be essential for the creation of new music; perhaps even **the concept of musical instruments just an old romantic burden** that would be better left aside [...]. New digital instruments conceived holistically and not as a conglomerate of several interchangeable components are scarce; even worse, **in most cases they are only performed by their creators.**"<sup>1</sup>

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<sup>1</sup>Jordà, S. (2007). Interactivity and live computer music. Computer Music Journal.

Who are the "customers"?

- ▶ Which is/was the last "successful" DMI...?
- ▶ Which is/was the last "successful" non-digital instrument...?



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# Output Diversity

Jordà's classification (2007):<sup>2</sup>

- ▶ Macro-diversity
- ▶ Mid-diversity
- ▶ Micro-diversity

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<sup>2</sup>Jordà, S. (2004). Digital Instruments and Players : Part II – Diversity, Freedom and Control, (January 2004).

# Output Diversity

Jordà's classification (2007)

Macro-diversity (MacD)

- ▶ Context flexibility/versatility
- ▶ Generic vs specialized
- ▶ Correlation with player's expertise level

# Output Diversity

Jordà's classification (2007)

Mid-diversity (MidD)

- ▶ Inter-performance diversity
- ▶ Low MidD:
  - ▶ *"Always playing the same piece"*
  - ▶ *"Good for fun but not to be taken too seriously"*

# Output Diversity

Jordà's classification (2007)

Micro-diversity (MicD)

- ▶ Intra-performance diversity
- ▶ Nuances: potential for virtuosi
- ▶ Expressivity

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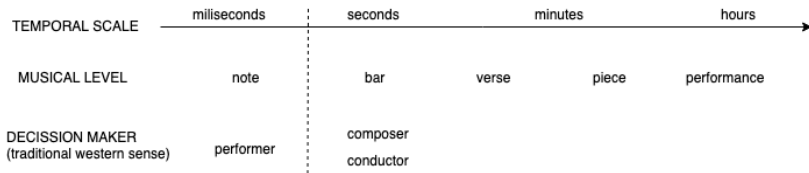
Apprenticeship

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# Multithread / Shared Control

## Music temporal scale



# Multithread / Shared Control

- ▶ Traditional instruments require continuous focus
- ▶ Traditional instruments affect up to note level (MicD)

But... DMIs do not need to follow these limitations!



# Multithread / Shared Control

## Multithread

- ▶ Focusing on several musical aspects at different times

## Shared Control

- ▶ Leave some decision-making to the computer

Towards a conductor/composer perspective.

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# Apprenticeship

Interaction modes with music performance are broad...

# Apprenticeship



# Apprenticeship



# Apprenticeship



# Apprenticeship



# Apprenticeship





# Apprenticeship

... so, different people in different moments have different requirements from instruments!

## Apprenticeship - Learning Curve



# Apprenticeship - Learning Curve

Learning Curve (Ebbinghaus, 1885)

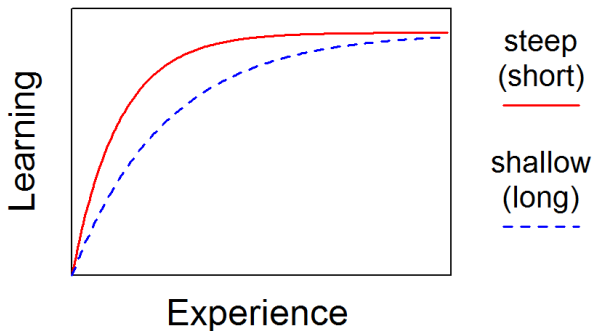
*"A learning curve is a graphical representation of how an increase in learning (measured on the vertical axis) comes from greater experience (the horizontal axis)."*<sup>3</sup>

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<sup>3</sup>Wikipedia. Learning Curve. Accessed 19/02/2019

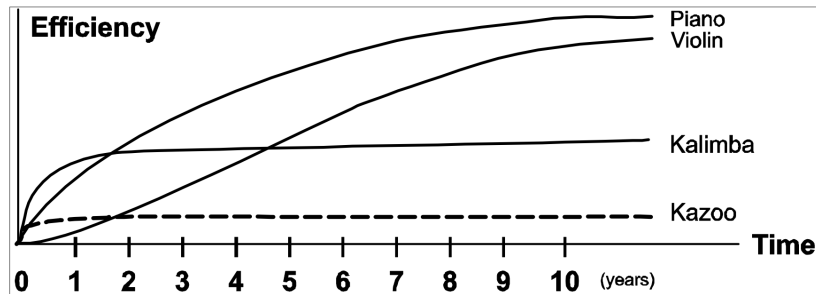
# Apprenticeship - Learning Curve

## Steep and Shallow



Drawn with 'R' using R-studio  
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# Apprenticeship - Learning Curve



Jordà, S. Digital Instruments and Players : Part I – Efficiency and Apprenticeship (2004).

# Apprenticeship - Learning Curve

Some important timestamps:

- ▶ *Rewarding Point*<sup>4</sup>
  - ▶ Enough skills to enjoy playing an instrument.
- ▶ *Mastering Point*
  - ▶ Time to completely master an instrument.
  - ▶ Usually taken as 10 years for the first acoustic instrument.<sup>5</sup>

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<sup>4</sup>Levitin D.J. et al. Control parameters for musical instruments: a foundation for new mappings of gesture to sound. Organised Sound (2002)

<sup>5</sup>Lehmann, A.C. The Acquisition of Expertise in Music: Efficiency of Deliberate Practice as a Moderating Variable in Accounting for Sub-Expert Performance (1997) .

*Efficiency (2b)<sup>6</sup>:*

*The ratio of the useful energy delivered by a dynamic system to the energy supplied to it.*

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}}$$

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<sup>6</sup>Merriam-Webster. Efficiency.

<https://www.merriam-webster.com/dictionary/efficiency>. Accessed 19/02/2019

# Apprenticeship - Efficiency

Musical Instrument Efficiency<sup>7</sup>:

$$\text{Efficiency} = \frac{\text{MusicalOutputComplexity}}{\text{ControlInputComplexity}}$$

Along time, the control input complexity might also increase..!

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<sup>7</sup>Jordà, S. Digital Instruments and Players : Part I – Efficiency and Apprenticeship (2004).



# Apprenticeship - Efficiency



# Apprenticeship - Efficiency

Corrected Musical Instrument Efficiency<sup>8</sup>:

$$\text{Efficiency} = \frac{\text{MusicalOutputComplexity} \times \text{PerformerFreedom}}{\text{ControllInputComplexity}}$$

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<sup>8</sup>Jordà, S. Digital Instruments and Players : Part I – Efficiency and Apprenticeship (2004).

## Performer freedom

*"A good instrument should not impose its music to its player. A good instrument should not be able to produce only good music! (What is good music anyway?) A good instrument should also be able to produce "terribly bad" music, either at the player's will or at the player's misuse."*<sup>9</sup>:

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<sup>9</sup>Jordà, S. Digital Instruments and Players : Part I – Efficiency and Apprenticeship (2004).

# Apprenticeship - Efficiency

Playing music vs. Playing with music

Musical Instrument vs. Musical Toy

# Apprenticeship - Efficiency

