Tutorial

ACOUSTIC ENHANCEMENT

BEN KOK
acoustic consulting

purpose

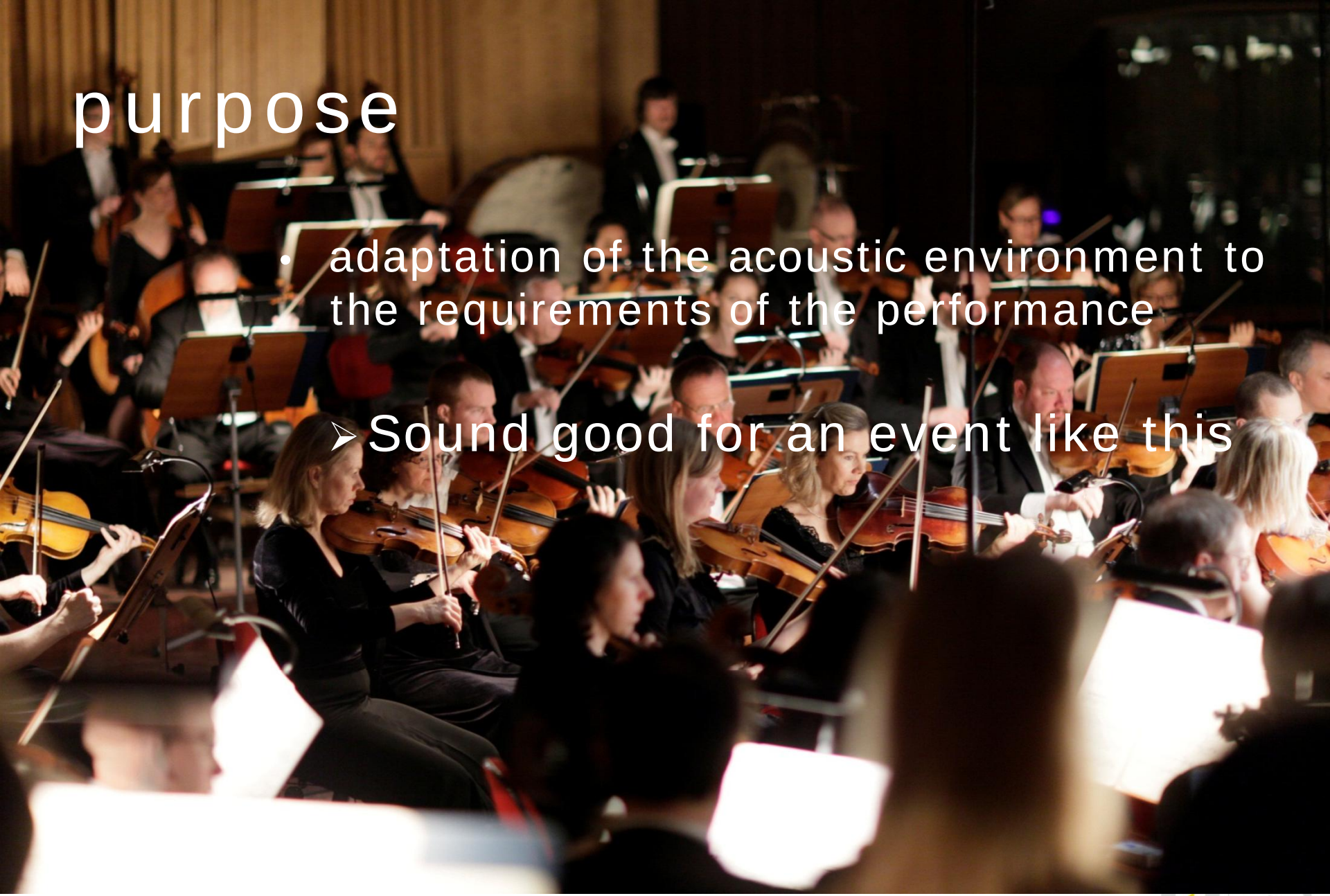
- adaptation of the acoustic environment to the requirements of the performance

➢A room suited for this

purpose

- adaptation of the acoustic environment to the requirements of the performance

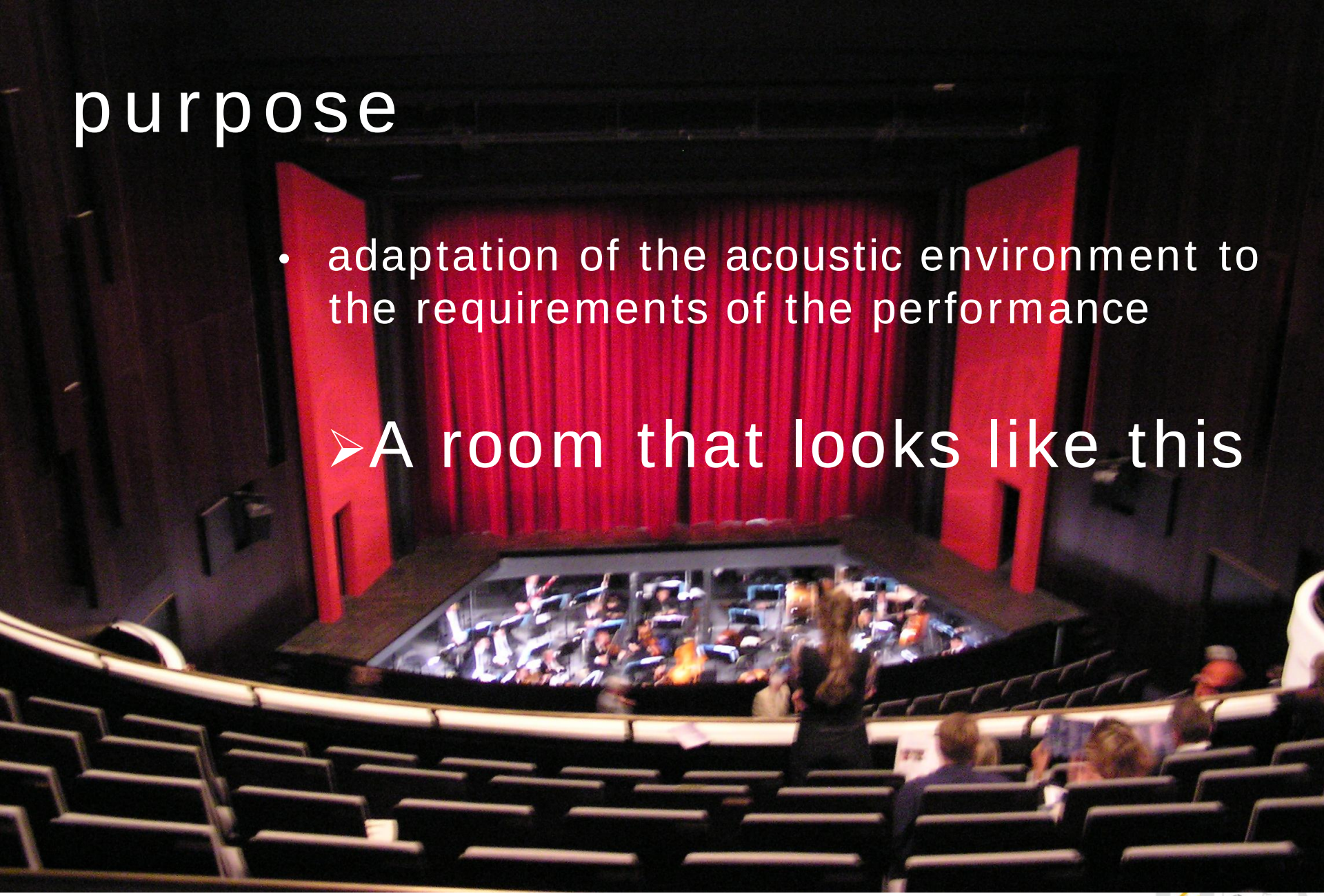
➢ Sound good for an event like this



purpose

- adaptation of the acoustic environment to the requirements of the performance

➢A room that looks like this



purpose

- adaptation of the acoustic environment to the requirements of the performance

➢To sound like a room like this

what?

- reverberation
- early reflections
- direction
  (lateral/medial/elevation)
- loudness

reverberation

natural acoustics:

- room volume
- absorption
- coupled rooms

reverberation

electronic enhancement:

- regeneration
- synthetic generation (in-line)
  - all pass filtering
  - multiple reflections/FIR filtering
  - sampled reverb/convolution

early reflections

natural acoustics:

- orientation of reflectors
- placement of absorption

electronic enhancement:

- electronic delay
- redistribution

direction

natural acoustics

- room shape
- distribution of absorption/reflection

electronic enhancement

- balance of loudspeakers in enhancement system

loudness

- passive/natural acoustics
  - inverse proportional to volume and absorption
- regeneration
  - proportional to RT60
- in-line
  - relatively independent of acoustic parameters

electronic systems
acoustic feedback

ways to control:

- microphone configuration
- loudspeaker configuration
- loudspeaker/microphone relation

electronic systems stability improvement

- multiple (independent) channels
  - band limited - high gain/channel
  - wide band – low gain/channel
- linear EQ
- de-correlation
  - time variant
  - time invariant
- echo cancelling

implementations

RODS

Assisted Resonance

ERES

WFS

LARES

VAP

AFC

ACS

Carmen

MCR

Vivace

SIAP

Constellation/VRAS

implementations reverberation generation

	regeneration	all pass	FIR	convolution
MCR	X			
LARES		X		
ACS			X	
SIAP			X	
Carmen	X			
Constellation	X	?	?	
Vivace				X
VAP	X			X

implementations signal pick-up

	direct	intermediate	reverb	no. micr.
MCR			X	large
LARES		X		small
ACS	X			medium
SIAP		X		small
Carmen			X	medium/large
Constellation			X	large
Vivace		X		small
VAP			X	medium/large

implementations
early reflection control

MCR	no
LARES	limited
ACS	yes
SIAP	yes
Carmen	no
Constellation	yes
Vivace	yes
VAP	no

implementations direction

MCR	no
LARES	yes
ACS	yes
SIAP	yes
Carmen	no
Constellation	?
Vivace	yes
VAP	limited

implementations gain

MCR	proportional to RT60
LARES	largely indep. of RT
ACS	largely indep. of RT
SIAP	largely indep. of RT
Carmen	proportional to RT60
Constellation	partly proportional to RT60
Vivace	largely indep. of RT
VAP	partly proportional to RT60

implementations
micr. - speaker relation

MCR	distant
LARES	distant
ACS	distant
SIAP	distant
Carmen	close
Constellation	distant
Vivace	distant
VAP	close

implementations decorrelation

MCR	microphone speaker distance
LARES	time variant
ACS	time variant
SIAP	time invariant
Carmen	time variant
Constellation	?
Vivace	time variant
VAP	time invariant

summary

- regeneration systems
  offer good reverberation,
  essentially RT variation only
- in-line systems
  early reflection manipulation,
  RT quality dependent on the reverberator
- microphone configuration
  has significant influence on enhancement capabilities

Remember

- there is more to acoustics than just RT60
- acoustics should not be noticed

worth reading

Design Criteria for Acoustic Enhancement Systems

Ben Kok, Wim Prinssen

6th ICSV, Copenhagen, July 1999

Variable Acoustics means Variation of Reverberation Time – does it?

Ben Kok

NAG-DAGA, Rotterdam, March 2009

THANK YOU

ben@benkok.com
www. benkok.com
www.linkedin.com/in/benkok