WHAT A WASTE OF TIME

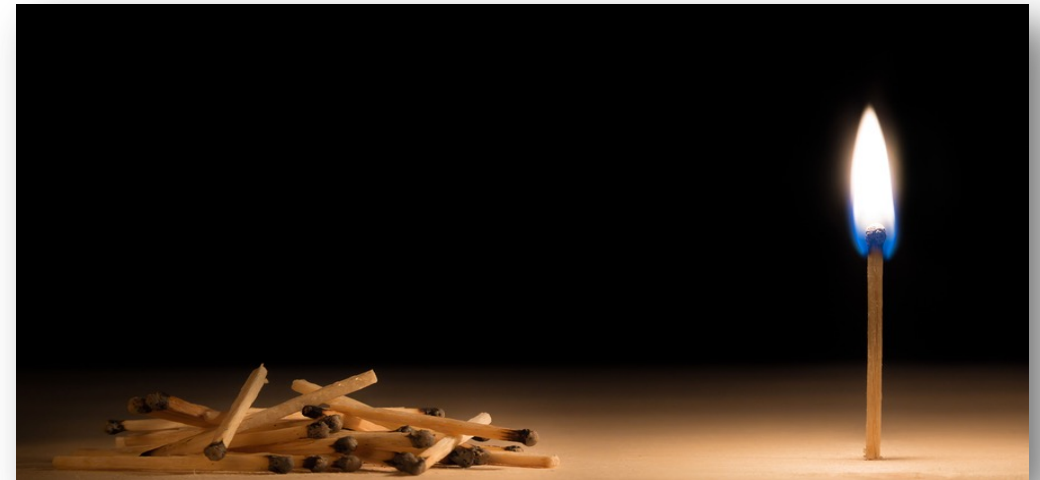**Søren Wandahl**, Aarhus University

Hasse H. Neve, PricewaterhouseCoopers

Jon Lerche, Aarhus University

AGENDA

- Waste in construction
- Measuring time waste
- Results of meta study
- The importance of improving direct work
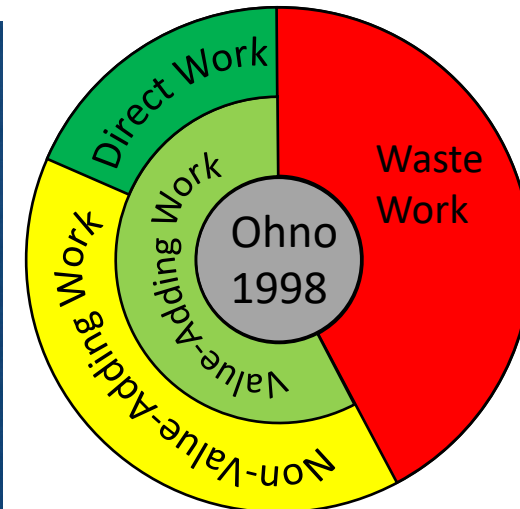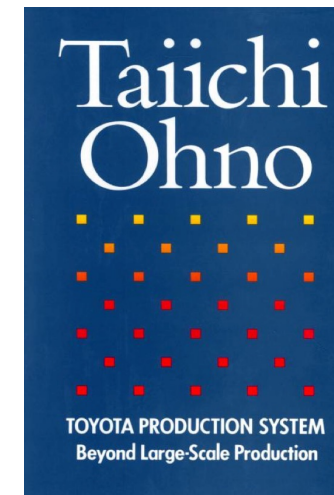- Three key take aways

WASTE IN CONSTRUCTION

- Elimination of waste is a core focus of LC (e.g. Koskela 2000)
- 7 waste types + Making-do waste (Koskela 2004)
- Purpose is to be efficient (Tripple Bottom Line)
- Of all the factors which influence project profits, on-site labor costs are among the most influential (Gouett et al. 2011; Moselhi and Khan 2012; Tsehayae and Fayek 2016)
- 1/3 of all IGLC papers include time and/or waste in title or keyword
  - Takt Time (Frandson et al 2013)
  - Just-in-time (Tommelein and Li 1999)
  - Time use in production (e.g. Kalsaas 2010; Koskela 2004; Kalsaas 2012; Kalsaas & Bølviken 2010)
  - Waste as a concept (Koskela et al 2013; Bølviken et al 2014; Kalsaas 2013; Polat & Ballard 2014)
  - Making-do (e.g. Koskela 2004; Fireman &Formose 2013; Neve & Wandahl 2018; Fireman and Saurin 2020)

MEASURING TIME WASTE

- Kalsaas & Bølviken (2010):
  "...the current lack of an accepted method for measuring flow..."

- Flow "can" be measured as time waste
- Premise: flow cannot be understood without an understanding of waste and vice versa (Kalsaas 2013)

- *"not all that counts can be counted... On the other hand, we believe that in some cases, measurement can represent an important contribution towards providing a better factual foundation for our improvement work"* (Bølviken and Kalsaas 2011)

Taiichi Ohno

TOYOTA PRODUCTION SYSTEM
Beyond Large-Scale Production

Direct Work
Value-Adding Work
Non-Value-Adding Work
Waste Work
Ohno 1998

WORK SAMPLING – THE META STUDY

- The WS method quantifies how much time craftsmen use on DW and NVAW time
- Kalsaas et al conducted a review (*limited in extend and reliability*)

- Aim: conduct an extensive review to collect the largest sample of DW values in construction. A meta study of DW in construction, which could be applied for benchmark purposes, outline future direction in research, and guide industry in their quest of increasing efficiency of construction.

- The Database of WS studies was developed during some years

Data included in the meta study

| North America N=300	Europe N=73	Asia/Australia N=48	Africa N=40	South America N=13
(Agbulos and AbouRizk 2003; Allmon et al. 2000; Choy and Ruwanpura 2006; Christian and Hachey 1995; Da Silva 2006; Diekmann et al. 2004; Gong et al. 2011; Gouett et al. 2011; Handa and Abdalla 1989; Heinz 1984; Hewage and Ruwanpura 2006; Jenkins and Orth 2003; Jenkins and Orth 2004; Jergeas 2009; Lee et al. 1999; Liou and Borcherding 1986; Logcher and Collins 1978; Maryam 2012; Oglesby et al. 1989; Picard 2002; Rogge and Tucker 1982; Salim and Bernold 1994; Shahtaheri 2012; Shahtaheri et al. 2015; Siriwardana et al. 2017; Thomas 1981; Thomas and Daily 1983; Thomas and Holland 1980; Thomas et al. 1984; Tsehayae and Fayek 2016)	(Baxendale 1987; Björkman et al. 2010; Dirchsen and Gantriss 2015; Hajikazemi et al. 2017; Hammarlund and Rýden 1990; Horner et al. 1987; Jensen and Martiny 2016; Josephson and Björkman 2013; Kalsaas et al. 2014; Maarof and Easeph 2017; Neve and Wandahl 2018; Neve et al. 2020; Nielsen and Kristensen 2001; Olomolaiye 1990; Steevens 1987; Strandberg and Josephson 2005; Thune-Holm and Johansen 2006; Wandahl and Skovbogaard 2017; Winch and Carr 2001)	(Al-Ghamdi 1995; Chan and Kumaraswamy 1995; Chang et al. 2015; Enshassi et al. 2011; Hwang et al. 2018; Kaming et al. 1997; Kumar et al. 2014; Low and Chan 1997; Pradeepkumar and Loganathan 2015; Sheikh et al. 2017; Vilasini et al. 2014)	(Alinaitwe et al. 2006; Hosny et al. 1992; Olomolaiye et al. 1987; Parker and Mingwa 1987; Peer and North 1971; Shehata and El-Gohary 2011)	(Alarcón 1993; Alarcón and Ortíz 1995; Espinosa-Garza et al. 2017; Ramos and Iring 2006; Serpell et al. 1996; Serpell et al. 1995)

Data included in the metastudy

Trade	Sample (N)	Mean (μ)	Std. dev. (σ)
Brick & Tiles	27	46.2%	13.2%
Carpenter	26	43.9%	15.7%
Civil	10	31.2%	9.6%
Concrete	48	38.8%	19.0%
Electrical	22	47.4%	16.5%
HVAC	25	32.0%	16.1%
Steel	25	41.3%	20.4%
Unspecified or mixed	291	45.9%	15.6%

Year of study
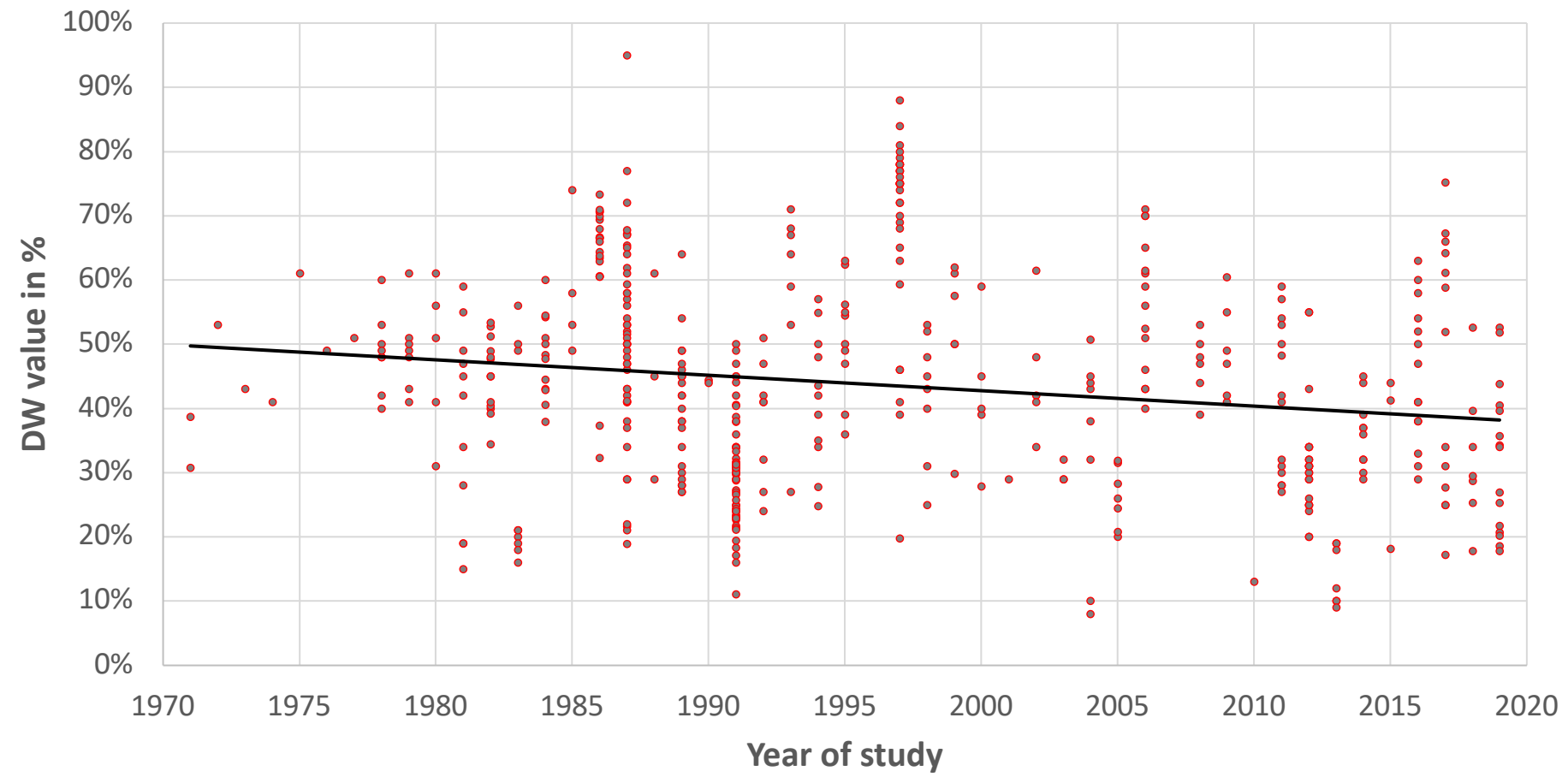
Histogram
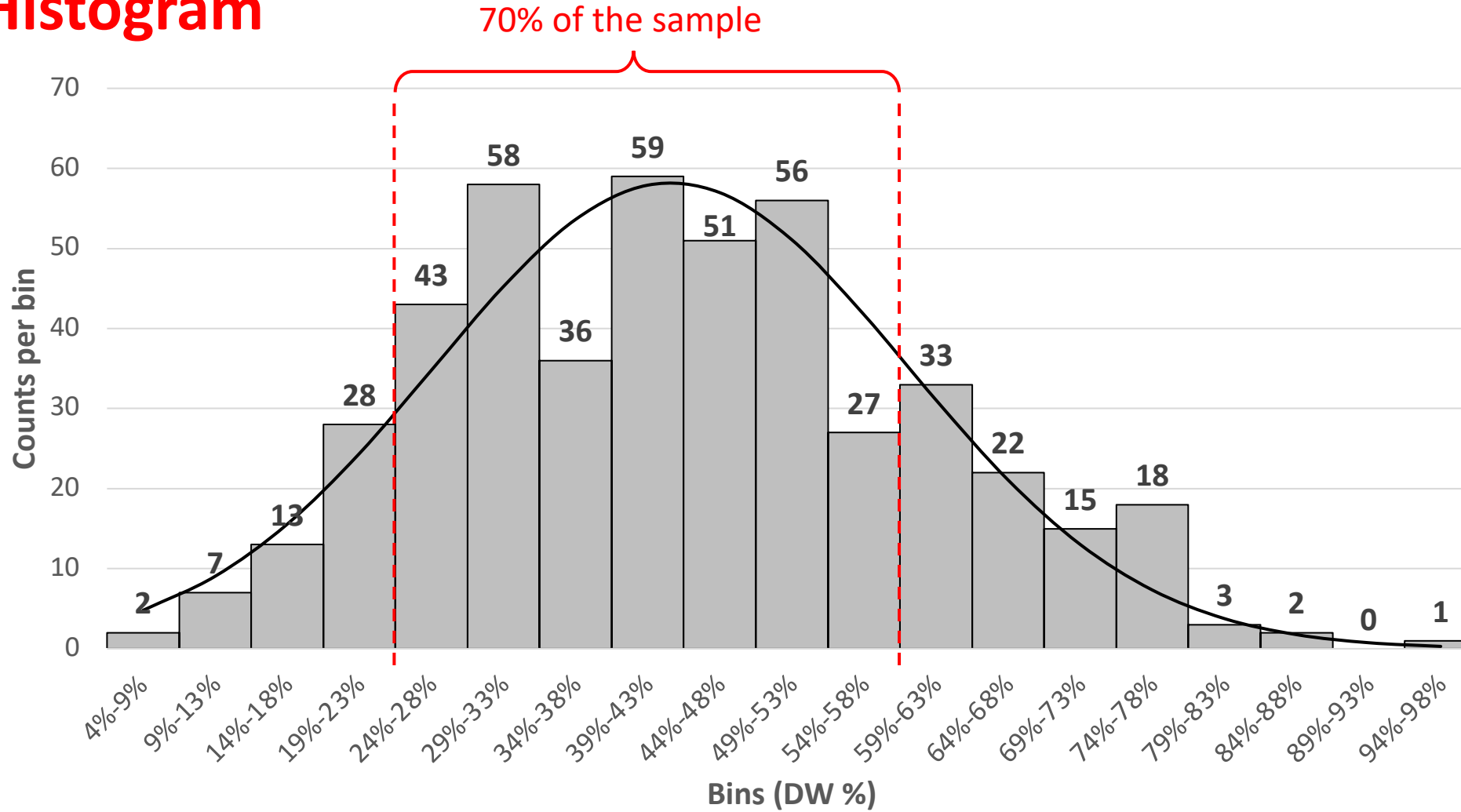
IMPORTANCE OF DW FOCUS

- Talking, preparation, and transportation = DW or WW or IW ?
- Depends on the perspective
- To understand and optimize, details are need
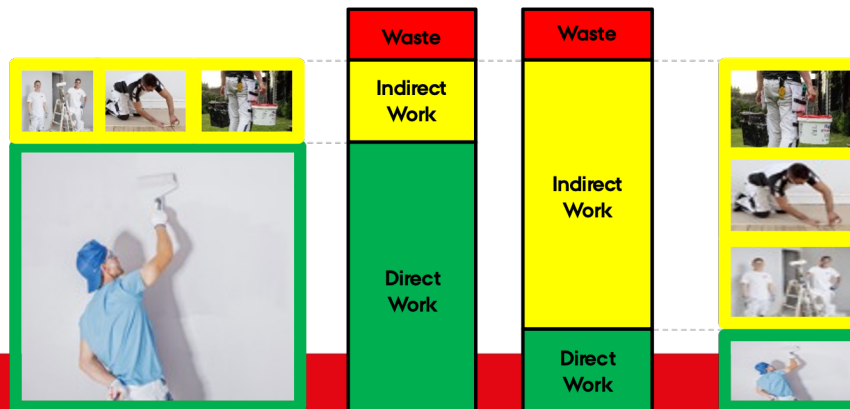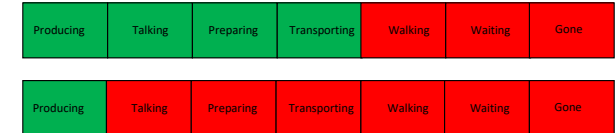
CONCLUSIONS

Apply Work Sampling to get a data-driven approach and to measure waste time

1

Work Sampling must include categories of DW, IW, and WW

2

We must aim to have as much DW as possible. Moreover, WS should be used to identify waste and NVAW

3

THANK YOU!

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