A Stakeholder-based Assessment Model (SAM) for resource-efficiency measures in the construction industry

M. Sc. Richard Müller

M. Sc. Olga Schamber

Dr. -Ing. Rebekka Volk

Prof. Dr. Frank Schultmann

Agenda

- **Motivation and research question**

- **Research approach**

- **Stakeholder-based Assessment Model (SAM)**

- **Outlook**

Agenda

- **Motivation and research question**

- **Research approach**

- **Stakeholder-based Assessment Model (SAM)**

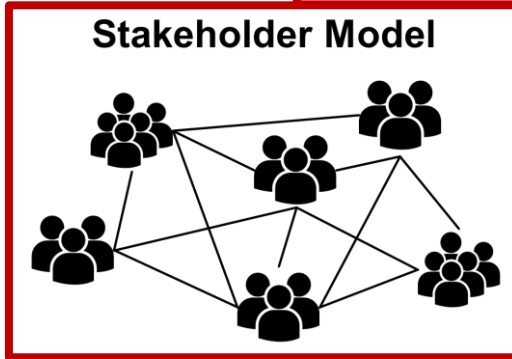- **Outlook**

Motivation and research question
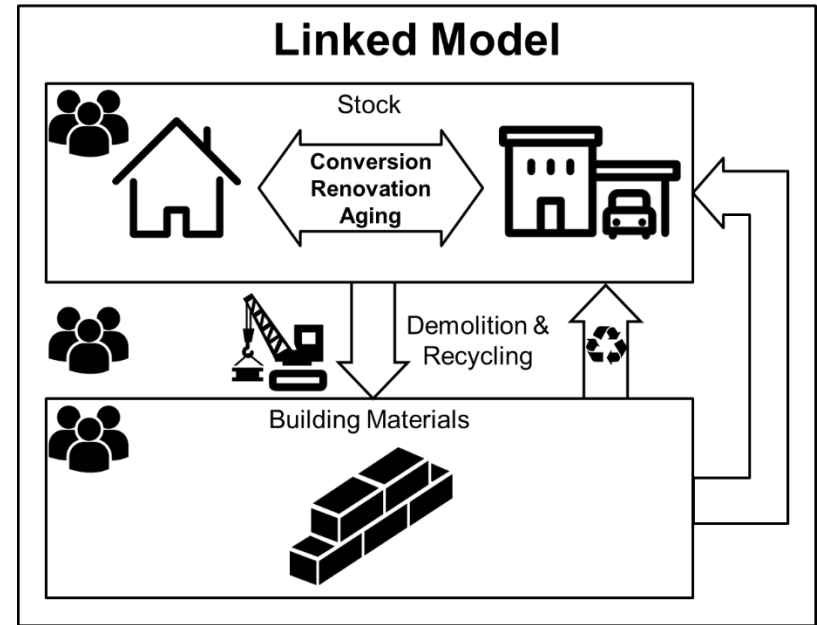

Material Flow Model

Input → Output
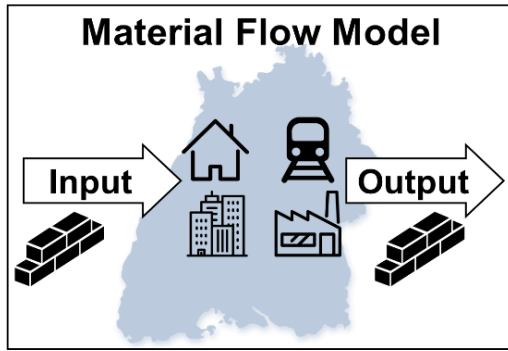
Hiete, M. et al. (2011)
Deilmann, C., Gruhler, K. (2005)
Schiller, G., Deilmann, C. (2010)
Gruhler, K., Böhm, R. (2011)
Deilmann, C., et al. (2017)

+ political measures

Stakeholder Model

Johnson, G., et al. (2006)
Olander, S. and Landin, A. (2005)
Bourne, L. and Walker, D.H. (2005)
Olander, S. (2006)
Mitchell, R.K., et al. (1997)
McElroy, B. and Mills, C. (2003)
Cleland, D.I. (1995)

=

Linked Model

Stock

Conversion Renovation Aging

Demolition & Recycling

Building Materials

Research question: What are the most effective political measures to incentivize the relevant stakeholders to reduce their resource consumption or increase the share of recyclables and recycling materials in their current practice?

- **Motivation and research question**

- **Research approach**

- **Stakeholder-based Assessment Model (SAM)**

- **Outlook**

Research approach

Goals:
- Reduce of the usage of primary raw materials by:
  - Higher usage of recycled raw materials as substitutes for primary resources
  - Increase of reuse and recycling of construction materials

Provide recommendations (effective measures) for political actions to foster the circular economy in the construction sector

Challenges / Research sub questions:
- **Many Stakeholders with different characteristics**
  - Who are the key stakeholders?
  - What ist their role in achieving the goal?
  - How strong is the influence of a stakeholder group on another group?
- **Many resource effiency measures**
  - What are the most effective measures?

Approaches in the Stakeholder-based Assessment model (SAM):
- Definition of the key Stakeholders
- Investigation of stakeholder's characteristics regarding their objectives and their potential impact on resource saving
- Investigation regarding:
  - Influence of a stakeholder group on another stakeholder group
  - present and future political resource saving measures
  - Effects of those measures on the environment and on the stakeholders

- **Conduct a Survey to collect more specific data**

Development of SAM

- **Motivation and research question**

- **Research approach**

- **Stakeholder-based Assessment Model (SAM)**

- **Outlook**

WORLD SBE HONG KONG 2017 WORLD Sustainable Built Environment Conference

Organisers: CONSTRUCTION INDUSTRY COUNCIL 建造業議會   HKGBC 香港綠色建築議會

International Co-owners: SBE SERIES   CIB   iiSBE   UNEP Sustainable Buildings and Climate Initiative   FIDIC   Global Alliance for Buildings and Construction

Stakeholder-based Assessment Model (SAM) – Model Overview

Stakeholder $a_i..a_n$

- **Objective function**
- **Readiness to act** according to a measure m_k

Stakeholder Network

Landfill sites

Construction planning

Builders

Public authorities

Government

Building Companies

Recycling Companies

Building materials Industry
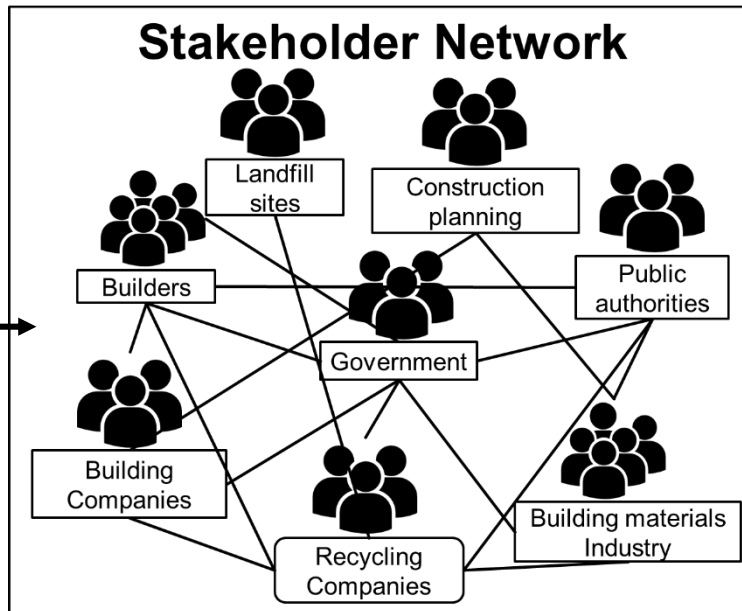
political measures $m_k..m_K$

Influence

Reduction of primary material used

Effectivity of the measure (defined as impact of a measure on the protection of resources)

Objective function of a stakeholder a_i

Environment
Public good
Environmentally responsible behaviour

Diederichs, C.J. (2012)

Financial
Profitability
Costs

Internal Business Process
Service quality
Customer satisfaction
Image
Customer relations

Objective Function

Customer
Service quality
Customer satisfaction
Image
Customer relations

Learning and Growth
education, productivity, technique, employee statisfaction

$$Z_{a_i} = g_{fin_{a_i}} * fin_{a_i} + g_{cust_{a_i}} * cust_{a_i} + g_{process_{a_i}} * process_{a_i} + g_{dev_{a_i}} * dev_{a_i} + g_{env_{a_i}} * env_{a_i}$$

fin_{a_i} = financial success of stakeholder a_i,
$cust_{a_i}$ = customer satisfaction of a_i,
$process_{a_i}$ = success of process design of a_i,
dev_{a_i} = development/Innovation success of a_i,
env_{a_i} = success of environmentally responsible behavior of a_i,
g_{factor} = weight of the variables and has to be defined for each Stakeholder (sum of all $g=1$)

SAM - Data generation

- 9 Expert Interviews (e.g. Construction Planning, Public authorities, Recycling Companies,..)
- using Likert-items to scale/quantify responses [1;5]

e.g. question 6:
Please evaluate the influence of your company on the business activity of the following stakeholders. [1;5]

e.q. question 7:
Please evaluate the influence of the following stakeholders on the business activity of your company. [1;5]

SAM - Calculation of the effectivity of a measure m

$$Eff(m_k) = \frac{1}{n} \sum_{i=1}^{n} \sqrt[3]{\frac{(l_{m_k} * r_{a_i}) * B_{a_i,m_k}}{250}}$$

$$B_{a_i,m_k} = \frac{Infl_{a_i} + 2\, w_{m_k,a_i} * s_{m_k}}{3}$$

$$Infl_{a_i} = \frac{\frac{1}{n} \sum_{i,j=1}^{n} (E_{a_i,a_j}(m_k))}{\frac{1}{n} \sum_{i,j=1}^{n} (e_{a_i,a_j})}$$

$$\forall\, k = 1, \ldots K$$

$$\forall\, i,j = 1, \ldots n$$

$$i \neq j$$

$$E_{a_i,a_j}(m_k) = w_{m_k,a_i} * s_{m_k} * e_{a_i,a_j}$$

$$w_{m_k,a_i} = g_{fin_{a_i}} * w_{m_k,fin_{a_i}} + g_{cust_{a_i}} * w_{m_k,cust_{a_i}} + g_{process_{a_i}} * w_{m_k,process_{a_i}} + g_{dev_{a_i}} * w_{m_k,dev_{a_i}} + g_{env_{a_i}} * w_{m_k,env_{a_i}}$$

Solved in Excel VBA

$Eff(m_k)$ = Effectivity of the measure m_k,

l_{m_k} = Impact of the measure m_k on the conservation of resources,

r_{a_i} = Influence of stakeholder a_i on the conservation of resources,

B_{a_i,m_k} = Readiness to act of stakeholder a_i while realizing measure m_k,

$Infl_{a_i}$ = Additional readiness to act / acceptance of stakeholder a_i,

$E_{a_i,a_j}(m_k)$ = Influence of stakeholder a_i on stakeholder a_j in dependence of measure m,

e_{a_i,a_j} = General level of influence of stakeholder a_i on stakeholder a_j

---

w_{m_k,a_i} = Impact (Imp.) of measure m_k on stakeholder a_i,

$w_{m_k,fin_{a_i}}$ = Imp. of m_k on financial success of a_i,

$w_{m_k,cust_{a_i}}$ = Imp. of m_k on customer satisfaction of a_i,

$w_{m_k,process_{a_i}}$ = Imp. of m_k on process design of a_i,

$w_{m_k,dev_{a_i}}$ = Imp. of m_k on development/innovation success of a_i,

$w_{m_k,env_{a_i}}$ = Imp. of m_k on environmentally responsible behaviour of a_i

SAM - Conclusion
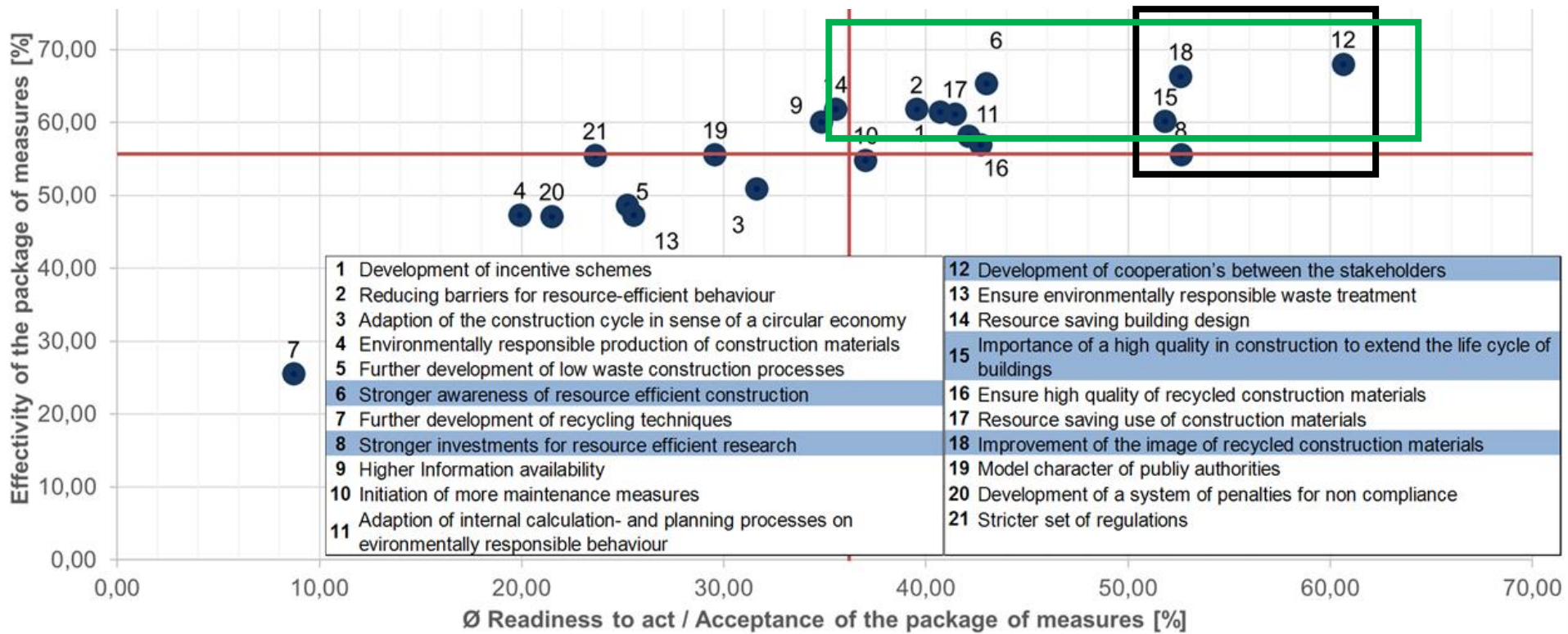
Highest effectivity | **Highest readiness to act**

- **Motivation and research question**

- **Research approach**

- **Stakeholder-based Assessment Model (SAM)**

- **Outlook**

WORLD SBE HONG KONG 2017

Organisers:
CONSTRUCTION INDUSTRY COUNCIL 建造業議會
HKGBC 香港綠色建築議會

International Co-owners:
SBE SERIES
CIB
iiSBE
UNEP Sustainable Buildings and Climate Initiative
FIDIC
Global Alliance for Buildings and Construction

WORLD Sustainable Built Environment Conference

Outlook

Next steps:

- Impact of SAM on Material Flows
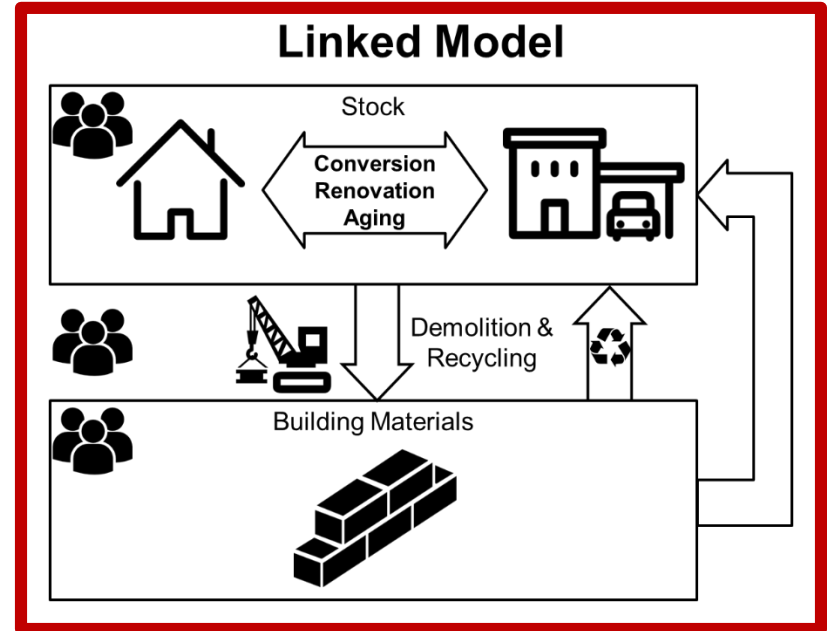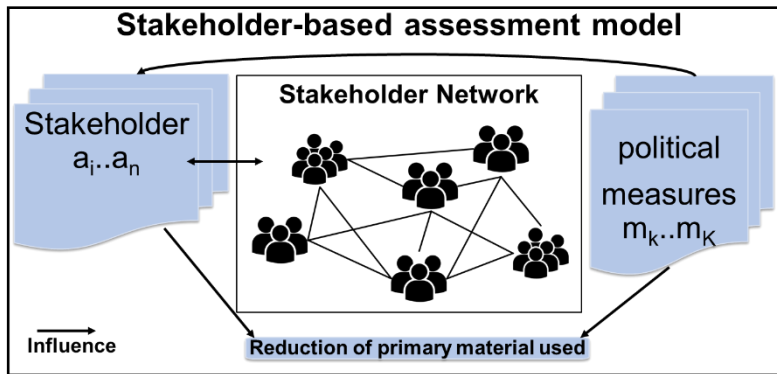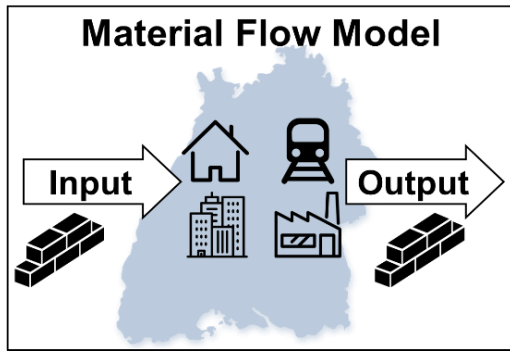- Impact of synergies between political measures on material flows
- Improvement of data, based on surveys (distributed through associations of the constr. industry)

Literature

Hiete, M. et al. (2011), Matching construction and demolition waste supply to recycling demand: a regional management chain model, Karlsruhe Institute of Technology (KIT), Building Research & Information 39(4), 333-351

Deilmann, C., Gruhler, K. (2005), Stoff- und Energieflüsse von Gebäuden und Infrastrukturen als Grundlage für ein vorausschauendes szenariogeleitetes Stoffstrommanagement,

Schiller, G., Deilmann, C. (2010), Ermittlung von Ressourcenschonungspotenzialen bei der Verwertung von Bauabfällen und Erarbeitung von Empfehlungen zu deren Nutzung, Umweltforschungsplan des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit (UBA)

Gruhler, K., Böhm, R. (2011), Auswirkungen des demografischen Wandels auf das Stofflager und die Stoffflüsse des Wohngebäudebestandes – Deutschland 2050 –, Leibniz-Institut für ökologische Raumentwicklung Dresden e.V.

Deilmann, C. et al. (2017), Materialströme im Hochbau – Potenziale für eine Kreislaufwirtschaft, Forschung für die Praxis Band 6

Johnson, G., Scholes, K. and Whittington, R. (2006), Exploring corporate strategy, 7th ed., Financial Times Prentice Hall, Harlow u.a.

Olander, S. and Landin, A. (2005), Evaluation of stakeholder influence in the implementation of construction projects, International Journal of Project Management, Vol. 23 No. 4, pp. 321–328.

Literature

Bourne, L. and Walker, D.H. (2005), Visualizing and mapping stakeholder influence, Management decision, Vol. 43 No. 5, pp. 649–660.

Olander, S. (2006), External stakeholder analysis in construction project management, Construction management publications, Lund University, Lund.

Mitchell, R.K., Agle, B.R. and Wood, D.J. (1997), "Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts", Academy of Management Review, Vol. 22 No. 4, pp. 853–886.

McElroy, B. and Mills, C. (2003), "Managing stakeholders", in Turner, J.R. (Ed.), People in project management, Gower, Aldershot, pp. 757–775.

Cleland, D.I. (1995), "Leadership and the project-management body of knowledge", International Journal of Project Management, Vol. 13 No. 2, pp. 83–88.

Diederichs, C.J. (2012), "Bauwirtschaft und Baubetrieb", in Zilch, K., Diederichs, C.J., Katzenbach, R. and Beckmann, K.J. (Eds.), Handbuch für Bauingenieure: Technik, Organisation und Wirtschaftlichkeit, 2., aktualisierte Auflage, Springer, Berlin, Heidelberg, pp. 379–965.

Thank you

Richard Müller M. Sc.

KIT – Karlsruhe Institute of Technology
Institute for Industrial Production (IIP)
French-German Institute for Environmental Research (DFIU)
Hertzstraße 16
76187 Karlsruhe
Tel.: +49 (0) 721 608 - 44587
Fax: +49 (0) 721 44682
E-Mail: richard.mueller@kit.edu,
Web: www.iip.kit.edu, www.dfiu.kit.edu