

Smart Readiness Indicator for Buildings

Experiences from a Cold Climate Country



Aalto-yliopisto
Aalto-universitetet
Aalto University



*Doctoral Candidate, Eerika Janhunen
Real Estate Business, Aalto University*

17.9.2019

Smart Readiness Indicator (SRI) for Buildings

What is an SRI for buildings?

- Methodological framework
- Calculation methodology

Experiences from a cold climate country

- Finnish SRI related project
- Case assessments

What is an SRI for buildings?

A framework for assessing the buildings' readiness for smart operation

Enforced under the revised EPBD (2018)

- 1st technical study: 02/2017-08/2018
- 2nd technical study: 12/2018-**07/2020**

Evaluates the building's ability to...

- improve its overall energy efficiency
- answer the occupants needs
- react to the grid signals

Aims at making the added value of building smartness more tangible for building users, owners, tenants and smart service providers

Methodological framework

SRI is based on the assessment of smart **ready** services

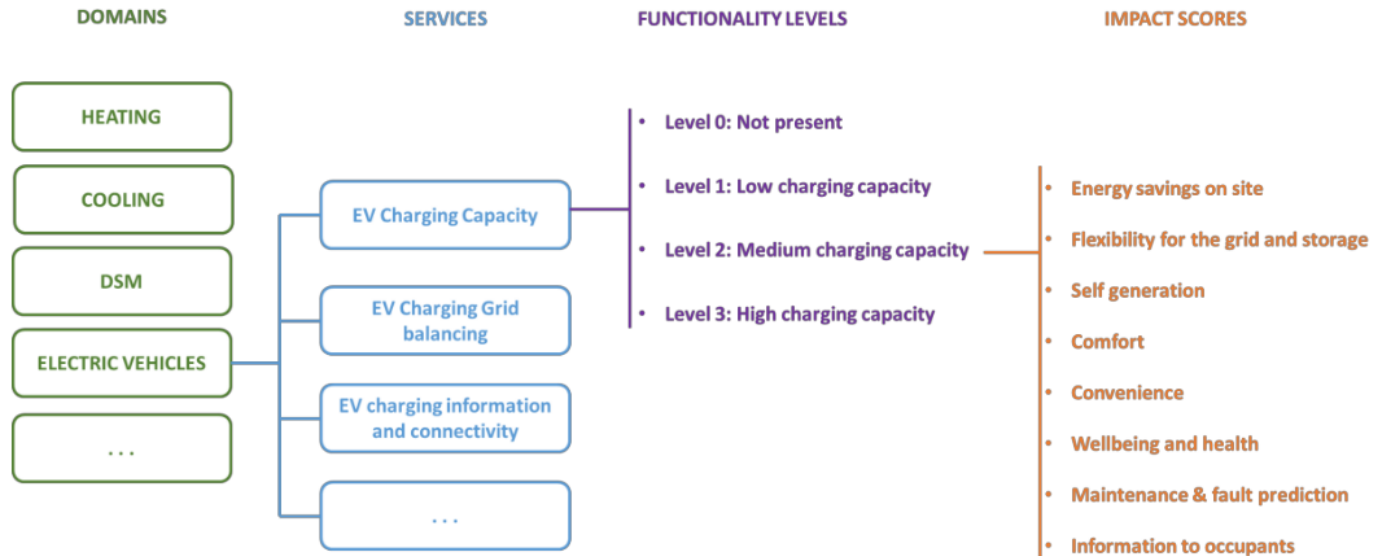
- A predefined list of 52 services
- 10 main domains

10 DOMAINS



Methodological framework

- Each service has 1-4 functionality levels (i.e. level of smartness)
- Each service (and the specified functionality levels) have an additional impact factor on eight impact categories



Calculation methodology

Step 1: Select the applicable services

Step 2: Determine the **actual** functionality level for each applicable service

Step 3: Apply service level impact scores

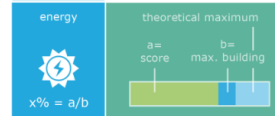
service A								
Functionality 0	0	0	0	0	0	0	1	0
Functionality 1	1	1	0	1	1	0	2	1
Functionality 2	2	2	1	2	1	0	3	2
Functionality 3	3	3	1	3	2	0	3	3

8 IMPACT CRITERIA

The total SRI score is based on average of total scores on 8 impact criteria.

energy	flexibility for the grid	self-generation	comfort	convenience	wellbeing & health	maintenance & fault prediction	information to occupants
x%	x%	x%	x%	x%	x%	x%	x%

An impact criterion score is expressed as a % of the maximum score that is achievable for the building type that is evaluated.



10 DOMAINS

One impact criterion score is the weighted average of 10 domain scores.

heating	A domain score is based on the individual scores for each of the services that are relevant for this domain.						domestic hot water			
	domain services	A	B	C	D	E	F			
y%	impact score (a) =	2	0	2	2	1	1			
	max. building score (b) =	3	3	2	2	1	3			

not every domain is considered to be relevant for each impact criterion

DOMAIN SERVICES

All relevant domain services are scored according to their functionality level.

service A	service B	service C	service D	service E	service F
Functionality 0	0	Functionality 0	0	Functionality 0	0
Functionality 1	1	Functionality 1	1	Functionality 1	1
Functionality 2	2	Functionality 2	2	Functionality 2	2
Functionality 3	3	Functionality 3	2	Functionality 3	3

Depending on the building type or design some services are not considered relevant.

Most of the services will affect also the other impact criteria's as shown in this overview matrix.

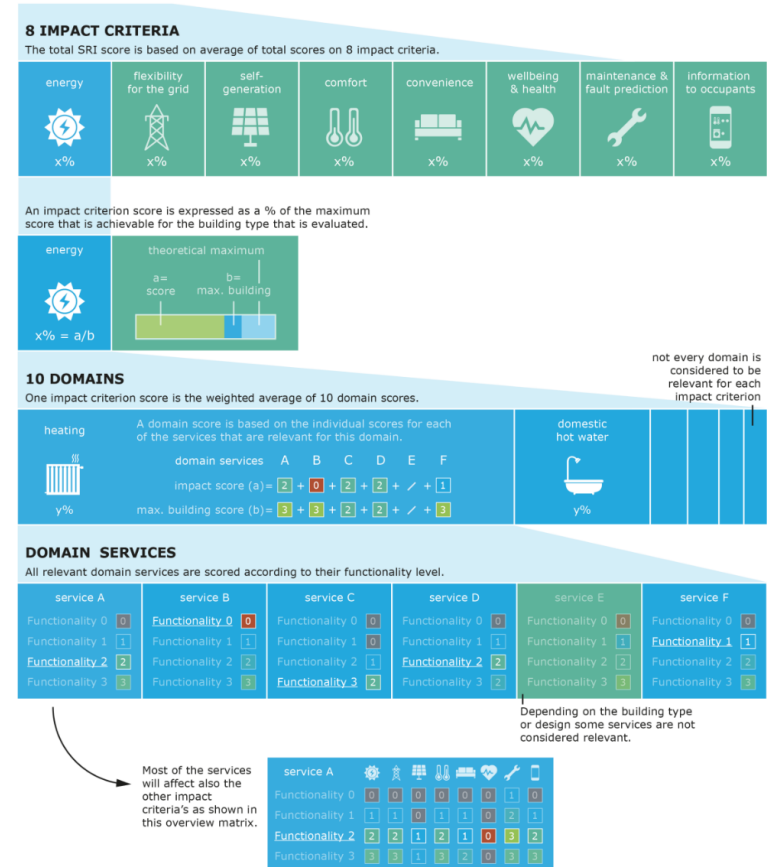
service A								
Functionality 0	0	0	0	0	0	0	1	0
Functionality 1	1	1	0	1	1	0	2	1
Functionality 2	2	2	1	2	1	0	3	2
Functionality 3	3	3	1	3	2	0	3	3

Calculation methodology

Step 4: Aggregate all scores and weight them by domains

Step 5: Calculate the **maximum** obtainable impact score (i.e. repeat the **steps 2 – 4**)

Step 6: The overall SRI score is calculated as the ratio of the **actual** impact score and the **maximum** obtainable score



The final score is solely dependent on the Step 1!

Experiences from a Cold Climate Country

SRI case assessments (Finland)

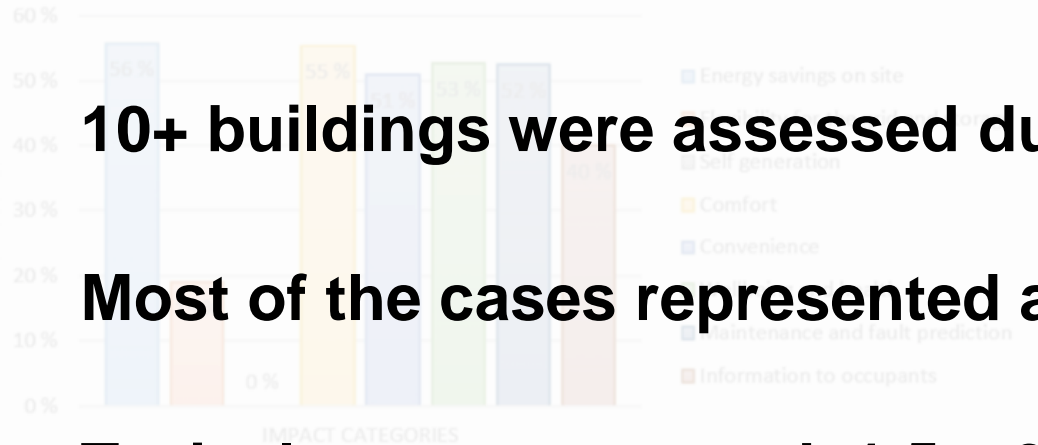
10+ buildings were assessed during the spring 2019

Most of the cases represented a state-of-the-art building

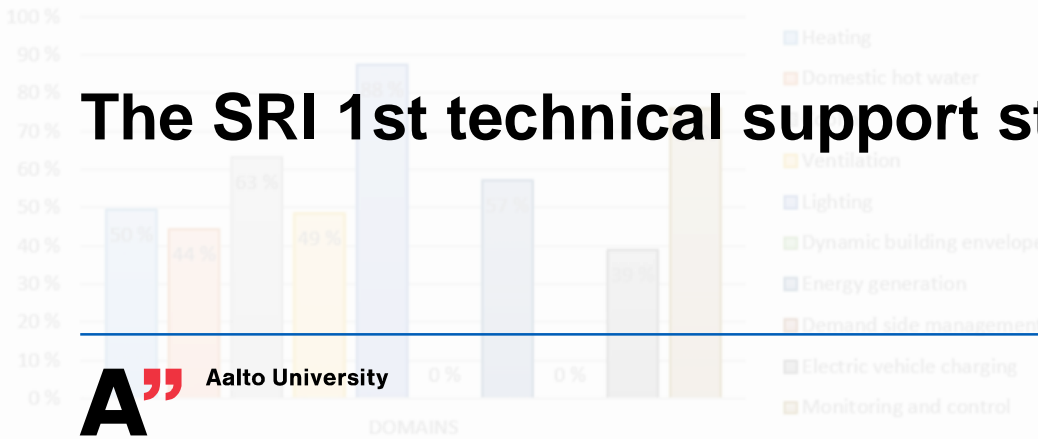
Typical assessment took 1,5 – 2 hours

The SRI 1st technical support study was applied

SRI SCORES BY IMPACT CATEGORIES

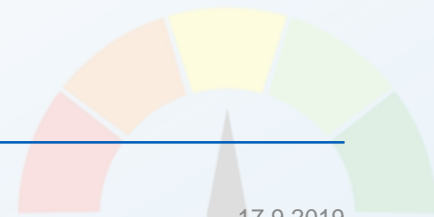


SRI SCORES BY DOMAINS



SRV/Derby

50%



Summary

Building Type	Year of Construction	Assessed Services	Absolute SRI Score	Relative SRI Score
Shopping Centre	2003	41/52	73 %	92 %
Office	1990	36/52	43 %	60 %
Office	2014	44/52	48 %	55 %
Educational	2018	45/52	47 %	52 %
Residential	2010	35/52	42 %	51 %
Office	2013	44/52	42 %	50 %
Educational	2015	33/52	35 %	46 %
Office	2004	36/52	35 %	46 %
Residential	2018	28/52	28 %	46 %
Hotel	(2020)	39/52	33 %	41 %
Residential	1967	20/52	11 %	40 %

Absolute SRI Score = Actual impact scores of the building / Maximum impact scores of all the 52 services

Relative SRI Score = Actual impact scores of the building / Maximum impact scores of all the assessed services

Design by Laura Remes



KOy Malminkaari 21

Project Data

Location	Helsinki, Finland
Year of Construction	1990
Type of Building	Office Building
Floor Area	6 998 m ²
Number of Floors	4
Environmental Certificate	BREEAM Very Good
Indoor Climate Class	S2

Basic Design Features

- District Heating + Water Radiators
- Mechanical Balanced Ventilation with Heat Recovery
- Passive Chilled Beams

↑ Intelligent monitoring control, 87,5 % of impact categories covered, most of them above medium level

↓ 30 % of domains not applied

?! Overall SRI score above the medium level as most of the impact categories

Design by Laura Remes

KOy Malminkaari 21

SRI score

60%

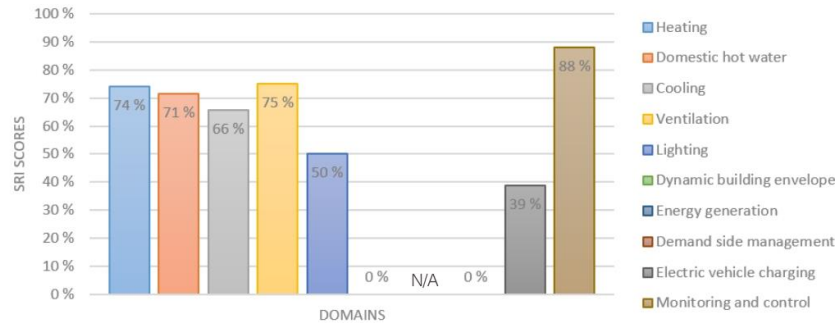


Design by Laura Remes

SRI SCORES BY IMPACT CATEGORIES



SRI SCORES BY DOMAINS



N/A - Category/domain is not assessed, because of irrelevance



- ↑ Intelligent lighting, automatic heating system, 90 % of domains covered
- ↓ Demand side management and storage of locally generated energy not applied
- ?! Low scores on energy generation, because there is no storage. The best energy class A!

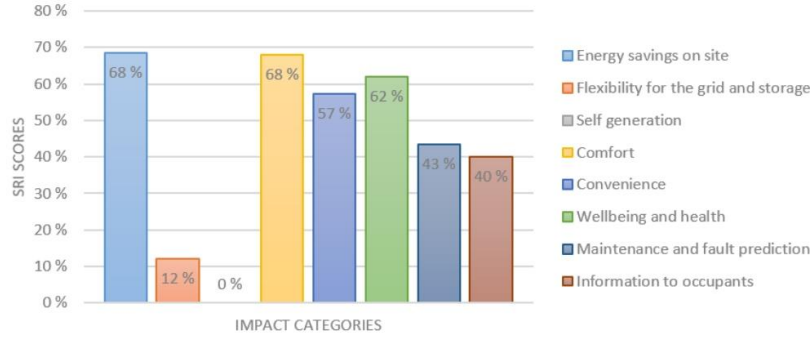
Väre

Project Data

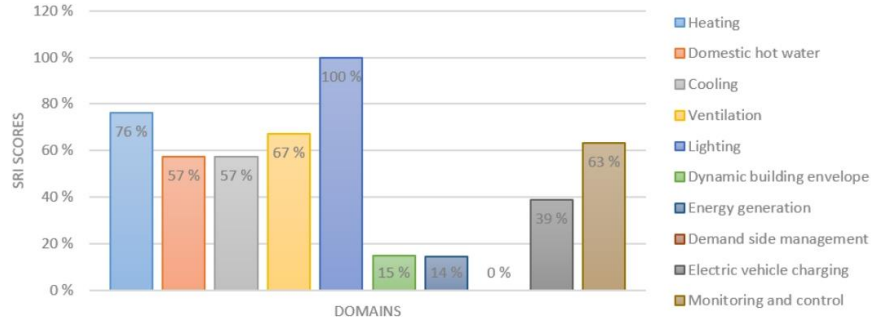
Location	Espoo, Finland
Year of Construction	2018
Type of Building	Educational Building
Floor Area	43 000 m ²
Number of Floors	4
Energy Class	A
Indoor Climate Class	S2
Basic Design Features	
<ul style="list-style-type: none"> ▪ Ground Source Heat Pump + Radiant Panels 	
<ul style="list-style-type: none"> ▪ District Heating for Supporting Heat Generation 	
<ul style="list-style-type: none"> ▪ Mechanical Balanced Ventilation with Heat Recovery <ul style="list-style-type: none"> ▪ Ground Coupled + Radiant Panels 	
<ul style="list-style-type: none"> ▪ Chillers for Supporting Cooling Generation <ul style="list-style-type: none"> ▪ Solar PV Utilization 	

Design by Laura Remes

SRI SCORES BY IMPACT CATEGORIES



SRI SCORES BY DOMAINS



N/A - Category/domain is not assessed, because of irrelevance

Väre

SRI score

52%



Design by Laura Remes



- ↑ 90 % of domains above medium level, 40 % of domains 100 %, high SRI scores for all impact categories, SRI A level
- ↓ Dynamic building envelope not applied
- ?! Part of the smart energy system, microgrid functionality. High SRI score is achievable with district heating.

Sello

Project Data

Location	Espoo, Finland
Year of Construction	2003
Type of Building	Shopping Centre
Floor Area	100 000 m ²
Number of Floors	N/A
Environmental Certificate	LEED Platinum
Indoor Climate Class	S2

Basic Design Features

- District Heating
 - Air Heating
- Mechanical Balanced Ventilation with Heat Recovery
 - Solar PV Utilization
 - Advanced Demand Management
 - Electricity Storage

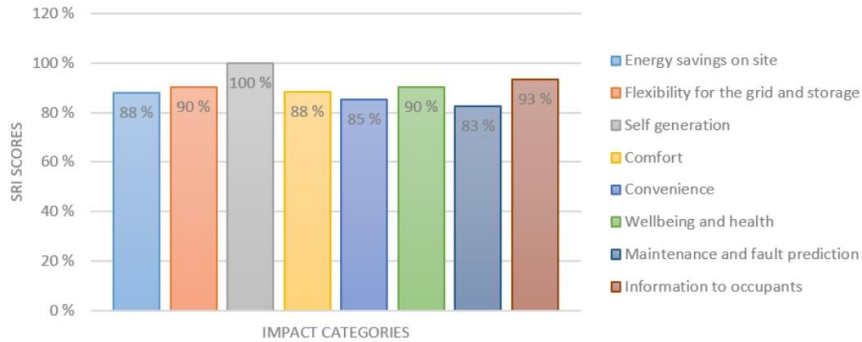
Design by Laura Remes

Sello

SRI score

92%

SRI SCORES BY IMPACT CATEGORIES



SRI SCORES BY DOMAINS



N/A - Category/domain is not assessed, because of irrelevance



Design by Laura Remes

Additional information

Smart Readiness Indicator (SRI) for Buildings:

<https://smartreadinessindicator.eu/>

Janhunen, E., Pulkka, L., Säynäjoki, A., & Junnila S. (2019). Applicability of the Smart Readiness Indicator for Cold Climate Countries. Buildings, 9(4), 102.

<https://www.mdpi.com/2075-5309/9/4/102>

THANK YOU!

