Automatic bike count a year round – challenges and development needs

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WHEN INFRASTRUCTURE COUNTS

SITO

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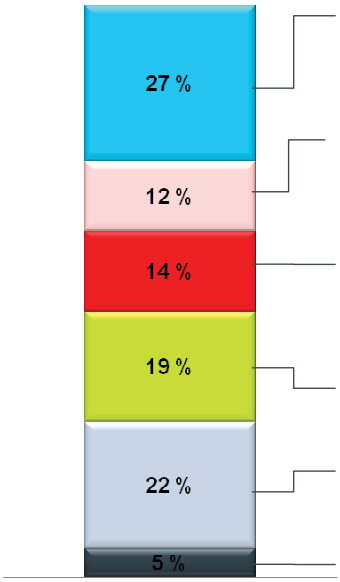
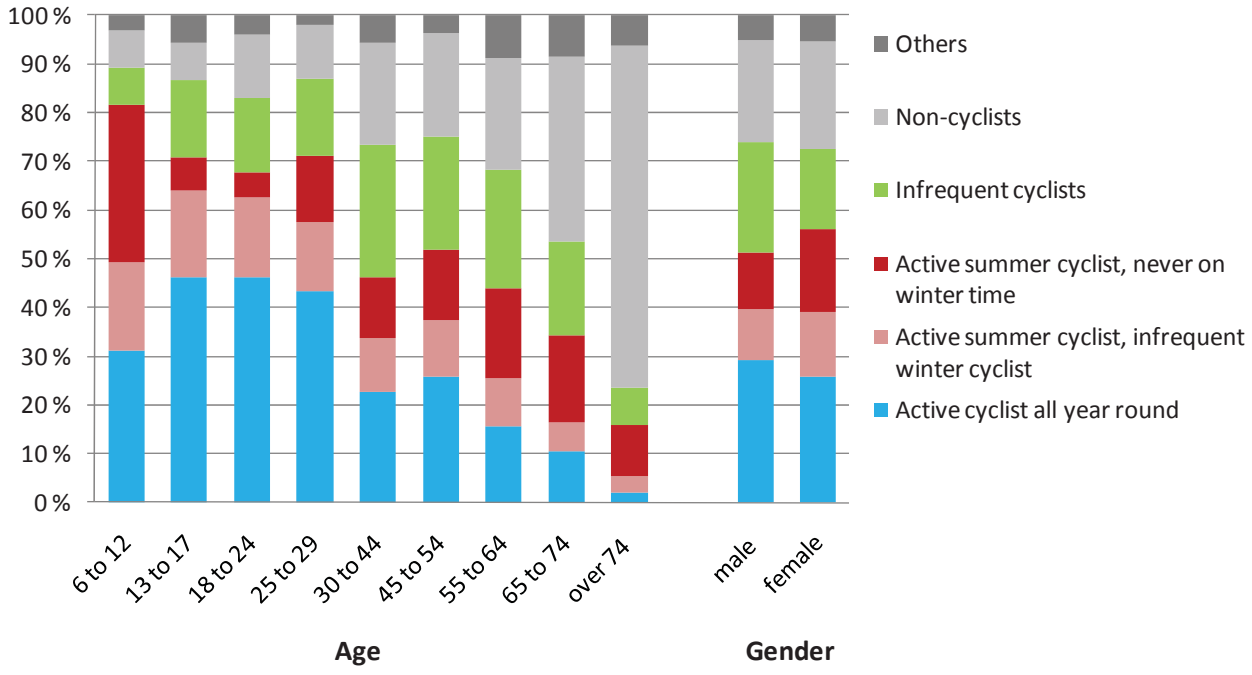
Cycling segments in City of Oulu (2009)



Population over 6 year old

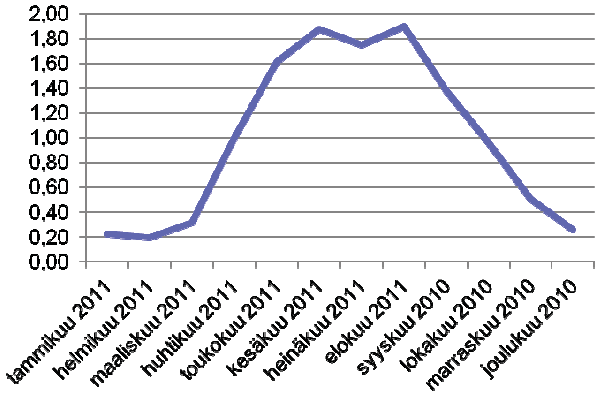
1. **Active cyclists all year round**
   Cycle daily or several times a weeks both summer and winter time
2. **Active summer cyclist, infrequent winter cyclist**
   Cycle daily or several times a weeks on summer time, but less than once a week on winter time
3. **Active summer cyclist, never on winter time**
   Cycle daily or several times a weeks on summer time, never on winter time
4. **Infrequent cyclists**
   Cycle summer time less than once a week, winter time even less
5. **Non-cyclists**
   Do not cycle
6. **Others**
   Missing answers made segmentation impossible

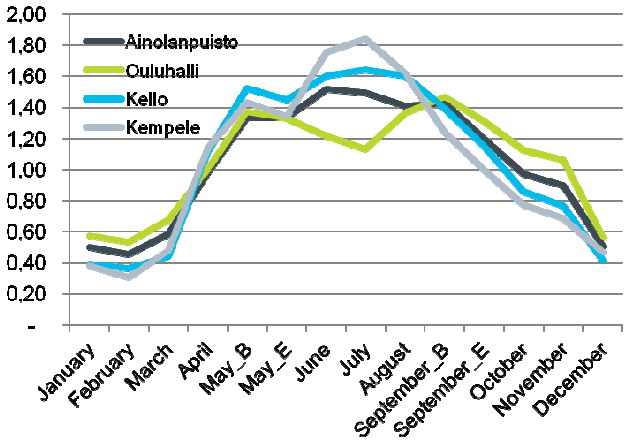
Cycling segments – Demographics (Oulu 2009)



Seasonal variation of cycling

Four counters in Oulu (year 2011)





Three counters in Tampere (year 2010-2011)

Why do we need to count the amount of cyclists?

- There are both national and local targets for the increasing amount and/or share of walking and cycling.
- Also in Oulu a vision is to increase the amount of bicycling.
- There is also a vision to make/keep Oulu the best winter cycling city in the world.

→ -We need better measures and methods for evaluating pedestrian and bicycle traffic all year round to follow up these targets.
-This information also serves traffic planning.

Problems in measures and methods for evaluating pedestrian and bicycle traffic

- Travel surveys are done quite infrequently, because they are expensive (every 5-10-20 years).
- Cycle and pedestrian counts are made with multiple ways in different cities and often not too systematic manner.
  - Often there is some fixed measurement points at a few places, but there is not a clear understanding what those represent.
  - Manual short counts are made at a relatively large number of places and the counts are scaled up to daily or annual values. Often some general national coefficients are used.
  - Weather data is sometimes collected, but the result are not corrected according to that.
  - Data is not collected in one database and corrected → it is not used.

- The vision in Oulu is to create a systematic system for pedestrian and cycling counting and follow-up. In the future, the information could be provided also in internet.

Thesis ´Equipments and Methods of Light Traffic Counting´

- Author Kimmo Karoluoto (Sito)
- http://urn.fi/URN:NBN:fi:amk-201104204598 (in Finnish)
- Financed by City of Oulu and ELY Centre of North Ostrobothnia (regional road authority)
- The main target of this thesis were:
  - to test different traffic counting devices for pedestrians and cyclists trying to find out accuracies and features of the devices.
  - to find out how different counting devices work in winter conditions.
- Testing was performed in January 2011.
- There are huge amount of techniques and equipments for traffic counting, only few were tested.

Five counting devices were tested

- Eco-combo with infrared sensors and inductive loops
- SDR traffic classifier
- Viacount II traffic counter
- Finnish Otos camera device
- Inductive loops of traffic lights.

Counter	Flexibility	Accuracy	Winter aspect
ECO combo (loops and infrared)	Permanent location	- Accurate cyclist counter. Pedestrian counting is more sensitive for errors. - The speed of the traffic do not effect the results.	Snow block easily the infrared censor → needs constant winter maintenance
SDR (radar)	Easy to install and move	- Accurate cyclist and pedestrian counter. - Very slow cyclist and fast pedestrians, and groups of pedestrians cause accuracy problems.	- Heavy rain causes inaccuracy. - Snow slows traffic down, which causes inaccuracy.
Viacount II (radar)	Easy to install and move	- Accurate cyclist counter. - Very slow cyclist cause accuracy problems.	- Heavy rain causes inaccuracy. - Snow slows traffic down, which causes inaccuracy.
Otos (camera)	Quite easy to move, but needs constant 240 V energy source	- Counts only total amount of pedestrian and cyclist, no classification (yet). - Good accuracy and suitable also for difficult places.	Seems to deal quite well with winter conditions.
Inductive loops (traffic lights)	Permanent location	- Counts only cyclists. - Accuracy is not good. However, seasonal variation can be measured correctly.	No special needs for winter maintenance.

Challenges of traffic counting in winter time

SNOW AND ICE..

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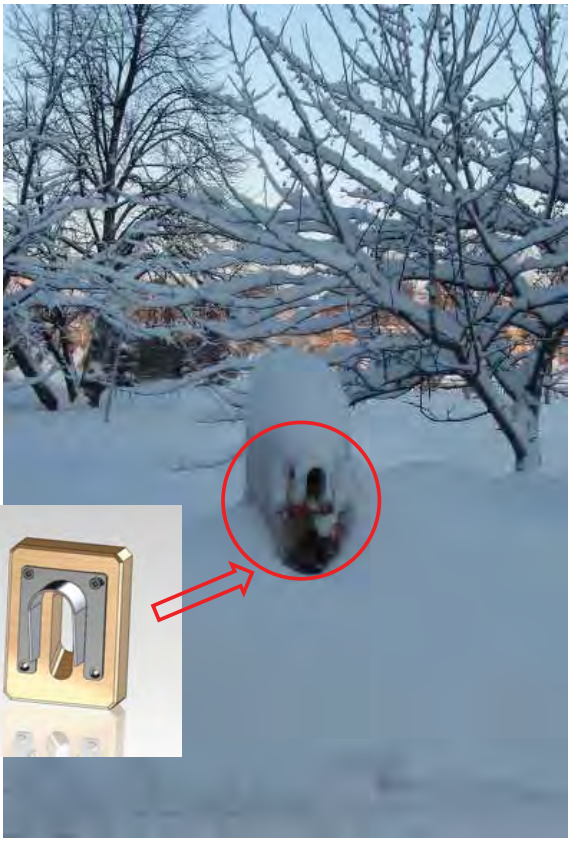
SNOW AND ICE....

- Winter conditions are challenging.
- Design and details are seldom planned for winter conditions.

Solutions

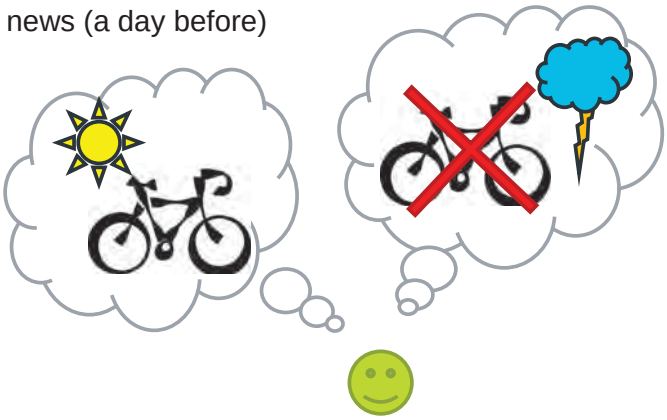
- Design
- Winter maintenance
- Only cyclist counting in winter time



Seasonal and weather variation of cycling – statistical model

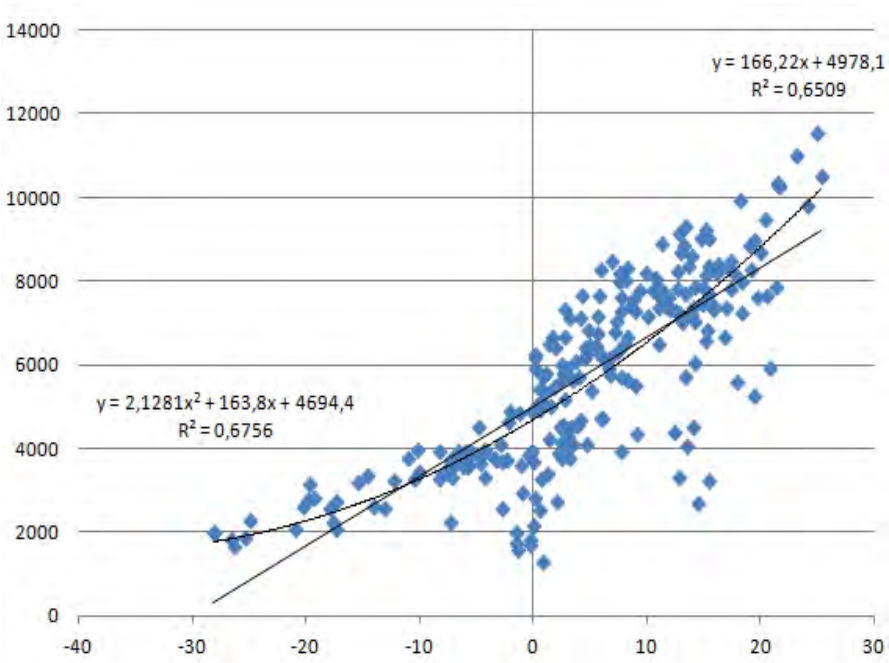
- The daily amount of cyclist in four eco-counter points in Oulu
- One year data (year 2011)
- Weather information
  - Actual measured data from weather stations
  - Forecasted data from daily TV news (a day before)

When the decision is made?



Amount of cyclist in different temperatures

The total amount of cyclist in in four counting points during weekdays



Daily average temperature (Celsius degrees)

Variables used in statistical model

Group of variables	Variable	Description
Weather (measured or forecasted)	Measured temperature	Continuous variable (Celsius degrees)
	Forecasted temperature	Continuous variable: average of forecasted temperature for the morning and for the afternoon
	Measured wind	Continuous variable (meters/second)
	Forecasted rain	Dummy variable. If either a morning or an afternoon was forecasted to be rainy, a day was classified as a rainy day.
Season/ day	Weekdays	Dummy variable
	Season	Dummy variables: spring, summer, winter, autumn
	School holidays (summer, winter, autumn, etc.)	Dummy variable

Some findings

- There were not a big difference between the explanation power of forecasted and measured temperature.
- Weekday as a variable has a very good explanation power.
- Already weekday and temperature together explain quite well the variation (R^2= 0,73).
- Quite simple model that included variables ´forecasted rainy day´, ´measured temperature´ and ´weekday dummy´ had good explanation power (R^2= 0,78)
- Variable ´School holidays´ has the best explanation power of all variables that explained season. It worked better than for example ´summer´.

Statistical model to explain daily amount of cyclist

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,922[a]	,850	,847	945,81921

a. Predictors: (Constant), Ennuste_koko (sade1), lomakausi, arki, W, C, kesä

Multiple regression was used, so called ”stepwise” method

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3630,383	149,512		24,282	,000
	Weekday	2518,329	114,477	,471	21,999	,000
	Summer	725,805	175,712	,142	4,131	,000
	School holiday	-1337,633	134,438	-,248	-9,950	,000
	Temperature	169,622	7,473	,759	22,697	,000
	Wind	-299,823	43,512	-,160	-6,891	,000
	Forecasted rainy day	-732,943	73,503	-,221	-9,972	,000

a. Dependent Variable: Kaikki_PP

Summary and Conclusions

- We need better measures and methods for evaluating pedestrian and bicycle traffic, and those methods have to work also in winter conditions.
- Winter time is challenging, but mostly counting devices seems to work quite well.
- With some details of design and with good winter maintenance, problems can be solved.
- We also need shared “databank” for counting results.

Thank You for you attencion!

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