

Summary:

Road safety program for Stockholm 2010-2020: Review and evaluation of goals, indicators and measures

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The goal of a 40% reduction of the annual numbers of killed or severely injured (KSI) road users in Stockholms stad until 2020 may be attained only if the goals for all chosen road safety indicators are attained, and otherwise only if there are considerable effects of factors that are not covered by the indicators. For most indicators however, goal attainment seems not very likely at present, unless considerable additional efforts are made, especially to reduce vehicle speeds and to improve the road infrastructure for pedestrians and cyclists. Improvements for pedestrians and cyclists should be in accordance with the indicators safe main roads, safe local roads and management and maintenance and additionally with the bicycle strategy and mobility plan. It is not recommended to adjust the overall goal, the indicators or the goals for the indicators. However, adjustments to the definitions of some indicators may be recommendable, especially to the speed and safe main roads indicators, in order to improve the coverage of effective safety measures that are under the responsibility of the municipality.

The main goal in the road safety program for Stockholm stad 2010-2020 is a reduction of the number of killed or severely injured (KSI) by 40% from an average of 278 in 2006-2009. Stockholms stad refers to the municipality of Stockholm. A number of sub-goals were identified, based on several road safety indicators: Speed, Safe main roads, Increased knowledge about road safety, Management and maintenance, Heavy vehicles, Safe local roads, Seat belt use, Bicycle helmet use, and Driving under the influence of alcohol (DUI). For each indicator a specific sub-goal is identified, which is meant to facilitate the identification of specific measures and continuous monitoring.

The present report is a follow-up of the report from 2009 (Sørensen et al., 2009) that has been the basis for the development of the goals, indicators and recommended measures. A detailed investigation has been made of the goal, sub-goals and indicators in the present road safety program.

For each indicator a target group has been identified, i.e. a group of KSI that are assumed to be affected by the indicator, and it has been investigated

- How the indicator has developed from 2006-2009 to 2012, how it is likely to develop until 2020 and what measures (planned and others) may contribute to improving the indicator

- How the number of KSI in the target group for the indicator is likely to develop until 2020 if everything except exposure remains unchanged, if the goal for the indicator is attained and if goal is partly attained (if the present development of the indicator continues until 2020); for some indicators it has also been investigated how additional measures that are not covered by the definition of the indicator may contribute to the number of KSI in the target group

Finally, aggregated calculations were made for the development of the number of KSI until 2020 in different scenarios: When the goals for all indicators are unattained, partly attained, or completely attained, including a scenario with the most likely changes for each indicator. Other factors that may affect the development of the number of KSI are discussed and taken into account as well. Based on these investigations and calculations, answers can be provided to a number of questions about the road safety program.

Present development: Are crash statistics and road safety indicators developing in accordance with the goals?

The present development of the numbers of KSI in Stockholms stad does not seem to be in the right direction. The total number of KSI has increased each year after 2009, especially among pedestrians and cyclists. However, it has been concluded that the observed increase probably is due to random variation rather than to a reversion of the long-term downward trend and no predictions are made for 2020 based on the development of the numbers of KSI during the past few years.

Table S.1 summarizes the present development of the indicators, including the status in 2006-2009 and 2012, the expected status in 2020 if the current trend continues and planned measures are implemented, and the goal for 2020. For the indicators speed, safe main roads, safe local roads, and management and maintenance (M&M) the current development is not sufficient. At present, the attainment of the goals for these indicators does not seem likely, but there are a number of effective measures that are under the responsibility of the municipality of Stockholm that may improve the development. For the indicators seat belt use, bicycle helmet use and driving under the influence of alcohol (DUI), the goals will most likely be attained or almost attained, but the effects on the numbers of KSI are limited and there is little the municipality can do to improve the development. For the indicators heavy vehicles and increased knowledge, there is at present no precise definition of the indicators and effects on the number of KSI in 2020 could not be estimated.

Table S.1: Status of the road safety indicators in 2006-2009, expected status in 2020 and status at goal attainment, incl. expected effects on KSI in 2020 at expected status and goal attainment.

	Status 2006-2009	Status in 2012	Expected in 2020 ¹	Goal ²
<u>Speed</u>				
<ul style="list-style-type: none"> ▪ Proportion of all vehicles driving at or below the speed limit 	50%	74%	83%	98%
<ul style="list-style-type: none"> Target group: KSI in crashes involving a motor vehicle 			(-14% KSI)	(-28% KSI)
<ul style="list-style-type: none"> ▪ Comments: The development is probably in the right direction, but the goal is not likely to be achieved without considerable additional efforts. Available information is however insufficient. Planned speed limit reductions will affect the indicator unfavorably, even if they will contribute to reducing the number of KSI in the target group for the indicator. A revision of the indicator is therefore recommended. 				
<u>Safe main roads</u>				
<ul style="list-style-type: none"> ▪ Proportion of safe GCM-passages⁴ 	18%	19%	22%	80%
<ul style="list-style-type: none"> Target group: Pedestrians and cyclists in motor vehicle crashes at GCM-passages 			(-10% KSI)	(-17% KSI)
<ul style="list-style-type: none"> ▪ Proportion of safe junctions 	51%	52%	62%	80%
<ul style="list-style-type: none"> Target group: KSI in crashes at junctions 			(-0.8% KSI)	(-1.3% KSI)
<ul style="list-style-type: none"> ▪ Comments: The present development is in the right direction, but far from sufficient to attain the goal. The empirical basis for estimating effects on the number of KSI in 2020 is insufficient. Possible effects of measures at schools are included in the effects of safe main roads. 				
<u>Increased knowledge about road safety</u>				
<ul style="list-style-type: none"> ▪ Measurement and analysis plan 	None	None	?	Existence of a plan
<ul style="list-style-type: none"> Target group: All KSI 				
<ul style="list-style-type: none"> ▪ Comments: The goal is imprecisely defined and no information is available about the development of a measurement and analysis plan. Effects on the number of KSI in 2020 could not be estimated. 				
<u>Management & Maintenance (M&M)</u>				
<ul style="list-style-type: none"> ▪ Standard of M&M on bicycle tracks 	?	?	Optimal on main network	Optimal on whole network
<ul style="list-style-type: none"> Target group: KSI cyclists in single crashes 			(-8.7% KSI)	(-29% KSI)
<ul style="list-style-type: none"> ▪ Standard of M&M on pedestrian facilities 	?	?	Optimal for 50% of pedestrians	Optimal for all pedestrians
<ul style="list-style-type: none"> Target group: KSI pedestrians in falls 			(-14.5% KSI ³)	(-29% KSI ³)
<ul style="list-style-type: none"> ▪ Standard of M&M on roads 	?	?	(KSI unchanged)	(KSI unchanged)
<ul style="list-style-type: none"> Target group: KSI motor vehicle occupants in single crashes 				
<ul style="list-style-type: none"> ▪ Comments: The likely development and effects on KSI are difficult to estimate because the status of the indicator in the present situation is not known. The empirical basis for estimating development until 2020 and effects on KSI is consequently insufficient. 				

Table S.1: Present development of the road safety indicators (continued).

	Status 2006-2009	Status in 2012	Expected in 2020 ¹	Goal
<u>Heavy vehicles</u>				
<ul style="list-style-type: none"> ▪ Heavy vehicle strategy 	None	None	?	Existence of a strategy
<p>Target group: KSI in crashes with a heavy vehicle</p> <p>▪ Comments: The goal is only imprecisely defined and no information is available about the development of a heavy vehicles strategy. No effects on the number of KSI in 2020 could be estimated.</p>				
<u>Safe local roads</u>				
<ul style="list-style-type: none"> ▪ Proportion of safe pedestrian / bicycle crossings 	16.7%	17.1%	19% (-11% KSI)	75% (-32% KSI)
<p>Target group: KSI pedestrians and cyclists in crashes involving a motor vehicle at GCM-passages on local roads</p> <p>▪ Comments: The present development is in the right direction, but far from sufficient to attain the goal. The empirical basis for estimating effects on the number of KSI in 2020 is insufficient.</p>				
<u>Seat belt use</u>				
<ul style="list-style-type: none"> ▪ Proportion of front seat occupants in passenger cars using the seat belt 	90.1%	97.1%	98-99% (-6 - -11% KSI)	98% (-6 - -10% KSI)
<p>Target group: Adult KSI front seat occ. in cars</p> <p>▪ Comments: The goal is likely to be attained if the present development continues. The expected effect on the number of KSI in the target group is however not large and uncertain.</p>				
<u>Bicycle helmet use</u>				
<ul style="list-style-type: none"> ▪ Proportion of all cyclists wearing a helmet 	56%	71%	92% (-1.3% KSI)	80% (-1.0% KSI)
<p>Target group: KSI cyclists</p> <p>▪ Comments: The goal will be more than attained if the present development continues. The expected effect on the number of KSI in the target group is however only small.</p>				
<u>Driving under the influence of alcohol (DUI)</u>				
<ul style="list-style-type: none"> ▪ Proportion of sober drivers (BAC < .20) 	99.56%	99.59%	99.63%	99.90%
<p>Target group: KSI in crashes with a motor vehicle involved</p> <p style="text-align: center;">or</p> <p style="text-align: center;">99.75% 99.78% 99.82%</p> <p style="text-align: center;">(-9%/-15%)</p> <p>▪ Comments: The current trend is in the right direction but not quite sufficient to attain the goal. The expected effect on the number of KSI in the target group is highly uncertain because of contradicting information about the status in 2006-2009 and because of the general inclination of drunk drivers to high-risk behavior and involvement in serious crashes.</p>				

¹ Expected status of the indicator in 2020 if present trend continues / if planned measures are implemented (bold) and expected change of the number of KSI in 2020 in the target group for the indicator if the indicator is as expected (in parentheses).

² Status of the indicator in 2020 at goal attainment (bold) and expected change of the number of KSI in 2020 in the target group of the indicator if the goal for the indicator is attained (in parentheses).

³ Refers to hospital reported KSI pedestrians (pedestrian falls are not included in official crash statistics).

⁴ Crosswalks: GCM = "gående, cykler, mopeder" (pedestrians, cyclists, mopeds)

The goal: Is the overall goal likely to be attained?

Aggregated calculations were made for all indicators in order to estimate changes of the number of KSI until 2020 in different scenarios for the development of traffic volumes, the indicators, additional measures, and external effects (other factors that affect road safety). In the aggregated scenarios

- **Traffic volumes** are either unchanged (which is unrealistic), increasing moderately for all road users, increasing more for motorized and moderately for unmotorized road users or increasing moderately for motorized and more for unmotorized road users
- **The indicators** are either unchanged on the level from 2006-2009 (which is unlikely), the goals for all indicators are attained (which is unlikely as well), the goals for all indicators are partly attained (which is more likely), or the most likely development for each indicator is assumed, including effects of additional measures that are not directly under the definition of the indicator but that affect the same type of KSI
- **External effects**, i.e. effects of factors that affect the numbers of KSI but that are not covered by any of the indicators, are absent, small (-10%), medium (-20%) or large (-30%); the assumed effects refer to the percentage reduction of the number of KSI in 2020 that can be attributed to external factors

The results show that the goal of a 40% reduction of the annual numbers of KSI in Stockholms stad until 2020 will not be attained unless the goals for all indicators are attained, and otherwise only if there are considerable effects of factors that are not covered by the indicators. More specifically, the goal may be attained

- When the goals for all indicators are achieved and when there are external effects of at least -10% (at least -20% in the traffic volumes scenario that predicts a larger increase of pedestrian and bicycle volumes); achieving the goals requires considerable additional efforts, especially for speed and safe main roads
- When the goals for all indicators are partly achieved and when there are external effects of at least -30% and / or effects of additional measures
- In the indicator-scenario “Likely changes” only when there are considerable external effects of at least 30%, except in the traffic volumes scenario that assumes larger increases of pedestrian and bicycle volumes; in this scenario the goal is not likely to be attained if all indicators develop according to the currently most likely scenario.

The results are similar for motorized and non-motorized road users. However, for pedestrians / cyclists a 40% reduction of the number of KSI seems somewhat more unlikely than for motor vehicle occupants and there are more scenarios that predict increases of the number of KSI. The main reason for the less favorable predicted development for pedestrians and cyclists is the likely increase of these road user groups.

The goal: Should the goal be revised in order to take into account hospital-reported injury statistics?

Current official crash statistics contain only police reported crashes and are most likely not affected by the increased reporting of hospital data. Hospital reported injury data do not need to be taken into account in interpreting results from official crash statistics and it is concluded that the goal should not be revised. Otherwise, the base of comparison (hospital reported crashes in 2006-2009) would not be adequate because of the increase of the number of hospitals reporting injuries in this period.

Road safety indicators and sub-goals: Are the present indicators and sub-goals sufficient?

If all goals for all indicators are attained, the overall goal may be (almost) attained if traffic volumes increase only moderately. The level of the goals seems therefore, overall, sufficiently ambitious. Some of the indicators might however benefit from revised (extended) definitions, especially the speed and safe main and local roads indicators. These have the greatest impact on the total number of KSI in Stockholm and they might benefit most from the suggested revisions. Suggested changes to the indicators are:

- **Speed:** It is recommended to supplement the speed indicator with a goal for reduced speed limits. Reduced speed limits will contribute to reducing average speeds, but they would affect the speed indicator as it is defined now negatively. The revised goal might be *“The proportion of all vehicles driving at or below the speed limit should not be below 98% and all roads should have reasonable speed limits”*. A precise definition for reasonable speed limits would have to be elaborated in “Rätt fart i staden”, according to the criterion that vehicles driving at or below the speed limit will not inflict disabling injury to any road users they may come into conflict with.
- **Safe main and local roads:** It is suggested to supplement the indicator with a goal for dedicated pedestrian and bicycle facilities. The definitions of safe main and local roads are quite narrow. A number of measures that affect the safety of bicycles and pedestrians are at present not covered by any of the indicators, even if they would favorably affect the number of KSI in the target groups for these two indicators. The revised goal might be: *“The proportion of safe junctions and GCM-passages should be at least 80% (75% on local roads), the proportion of the commuting and main bicycle networks with dedicated bicycle facilities and sufficient capacity should be at least 90% and walkability audits should reveal safety deficits on no more than 5% of the pedestrian infrastructure.”*
- **Increased knowledge about road safety:** A suggestion for a more precise definition of the increased knowledge indicator is: *“A systematic review of the development of road safety in Stockholm should be conducted (with a more specific description of how and how often), all those responsible for measures that (directly or indirectly) affect road safety should be involved in the reviews and there should be economic or other incentives to improve road safety.”*

- **Management & maintenance:** It is suggested to develop a precise definition of an “optimal standard” of management and maintenance which includes spring cleaning in addition to winter maintenance.
- **Heavy vehicles:** A suggestion for a more precise definition of the heavy vehicles indicator and corresponding goal for 2020 is: *“The most important safety problems with heavy vehicles are identified and measures have been taken that address the most important crash contributing factors (factors contributing to at least 50% of all heavy vehicle crashes with KSI).”*
- **Seat belt use:** No suggestions are made for changes to the seat belt indicator.
- **Bicycle helmet wearing:** Helmet use in general is likely to continue to increase, but the effect on the number of KSI is limited. However, among children, bicycle helmets are likely to have a greater effect than among adults and the municipality may have greater influence on helmet wearing rates. A possible redefined goal that also takes into account that increased cycling is an important goal as well is: *“The proportion of cyclists under 18 years who are wearing a bicycle helmet should be at least 90%, and no school children shall refrain from cycling because they do not have or do not want to wear a bicycle helmet.”*
- **DUI:** No suggestions are made for changes to the seat belt indicator.

Goal level and priorities: Should the present goal levels and priorities be changed?

The goal of a 40% reduction of the number of KSI in 2020 may be attained, unless there are no external effects or a traffic growth that is more than moderate. Goal attainment does at present not seem likely but becomes more likely if

- The goals for all indicators, and especially for the speed and safe main roads indicators, are attained, which requires considerable additional efforts
- The speed, safe main roads and safe local roads indicators are supplemented as described in the previous section
- A heavy vehicles indicator and goal is developed (and set into action)
- An increased knowledge indicator and goal is developed (and set into action)
- Increasing bicycle and pedestrian volumes are met by an infrastructure with a high safety level and sufficient capacity (or if pedestrian and bicycle volumes do not increase, this is however not desirable)

Since the goal is not impossible to be attained, but requires considerable efforts, it can still be regarded as both ambitious and realistic. It is therefore not suggested to change the goal or priorities (other than those changes that are suggested in the previous section).

Management and maintenance: Should a new indicator be defined for pedestrians and cyclists?

The M&M indicator affects a considerable number of KSI pedestrians (those injured or killed in falls) that are not represented in official police reported crash statistics. It is therefore suggested to extend the overall goal to include KSI pedestrians in falls. The goal would remain the same, only the number of KSI in the present and goal situation would be adjusted from 278 to $278 + 66 = 344$ in 2006-2009 and from 167 to 206 for the situation in which the goal is attained. 66 is the number of KSI pedestrians in falls in 2010 to 2012 (in 2006-2009 far fewer hospitals were reporting injuries).

Road safety plans and measures: Are the measures described in the annual road safety plans sufficient and implemented satisfactorily?

A number of measures are planned according to the road safety plans and according to the bicycle plan and mobility strategy. However, those measures that are currently planned to be implemented are not sufficient for attaining the goals for all indicators as has been discussed in the preceding sections, especially for the speed, safe main roads and safe local roads indicators. Specific plans that refer to the increased knowledge and heavy vehicles indicators are still more or less absent. It is suggested that such plans could improve the monitoring of the progress towards goal attainment if each measure that is described in the road safety plans were directly related to one of the indicators (except measures that are not relevant to any of the indicators), and if an overview were provided for each indicator about the current status, the goal and the degree to which the planned measures will contribute to goal attainment.