Google Translation of a Swedish Orienteering Federation paper
https://www.svenskorientering.se/globalassets/svenska-orienteringsforbundet/arrangera/kartfragor/kartskala/20181126_storre_kartskala_2019_synergonomi_bakgrundsfakta.pdf

IN-DEPTH DOCUMENT DOCUMENTS LARGER MAP SCALE, BOARD MEETING
3

Explanation of model for better understand readability for the elderly orienteers

VERSION 20181126

Properties of the orienteer that affect vision

Impaired contrast vision and need for light

There is no remedy, surgery or medicine for this. Normally aging and some normal disease states impair the contrast vision, change the color vision, make the eye more sensitive to glare, makes the lens of the eye more cloudy and everything blurred and darker. Easy simplified: It can only be compensated by changes in the map pressure.

Age view - the closest point

The near point grows with age. When the near point has grown to 400 - 500 mm, you get it reading glasses. With reading glasses (or the reading part of progressive glasses) you get a reading distance of 300 - 400 mm. The readability is quite directly inversely proportional to the reading distance. You can thus trick a better readability by using special lenses that give one shorter reading distance than 300 mm. However, such lenses are not suitable for everyone and after 50-55 years the eye's ability is not enough to see clearly at all distances even with such tricks. It gets blurry at some distance.

Because we want orientation to be easily accessible to everyone, without tricking, we adapt the maps to normal reading glasses distances, ie the range 300-400 mm. Long-sighted elite orienteers can already have problems with the readability of the map between the ages of 30 and 35. They can benefit from a contact lens in one eye. It can help them achieve well enough readability to continue the elite career.

Map reading training

Practice makes perfect. In the same way that a child first learns to recognize letters, then syllables, then words and finally small groups of words; in the same way gives orientation experience a better map reading skill. A very experienced orienteer reads (unconsciously) not just individual characters but wholes. When the age view comes so this orienteer manages to read the whole even though it is a bit blurred. A smaller experienced orienteers, who are dependent on reading individual characters, however, can not to read the individual characters because they are too blurred

Because we want the young people's parents, branch changers and anyone else to be able to start with orientation also in middle age, we do not adapt the maps to the most experienced the orienteers, but adapts them to such a readability that it also works without a long map reading experience.

Lighting conditions

The weather

The amount of light is important. If it gets too dark, the readability deteriorates. Older people need also more light. It is darker on a cloudy day than on a sunny day.

Be in the woods

It is darker in the forest than in an open field.

The time of day and year

It is darker in autumn than in summer. An O-ring map does not need as much magnification as a map to be used in October-November.

The map

Line width and symbol size

The most important factor for the readability of the map is the line width and the symbol size. The eye need a certain size, ie space angle, to be able to see well. The angle of space depends on the size in millimeters and the reading distance. Because elite under 30 can read down on under 100 mm distance, and older people can not read at a distance closer than 300-400 mm distance, our veteran maps should actually have 3-4 times the line width and font size for that veterans should have the opportunity to achieve the same enjoyment and readability at all as an elite under 30 years.

Generalization

The second most important detail we often call generalization. For the map to be easy to read the right line width and symbol size are not enough, enough is needed with distance ("white") between the details. In addition, a "variation" in the content is also needed on the map, so that everything does not look like a smooth porridge.

• The recommended way to solve this is to generalize the map and not take
with all the details.
• Sometimes certain parts of the terrain do not allow such a solution and you need to take
with more details. Occasional deviations from the map norm may then occur
the map, but systematically deviating from the map norm should not be needed and is
therefore not permitted under the regulations.

If the map is so detailed that deviations from the map norm occur, it is often an idea
to apply for an exemption for a larger map scale.
The magnification should then be done for all classes that have courses that are affected by the areas
the dispensation refers to. The person granting the exemption should be clear about this.

Rocky terrain and dense forest

If the map has a lot of rocky terrain (yellow or gray) or very dense forest, it is not
symbol background more white. Then the lines and the contrast of the symbols deteriorate, which
impairs readability. The deterioration is proportionally greater in older age.

If the map has a lot of rocky terrain or green, one or two extra steps may be needed
magnification.

Use of color

The basic readability of the map does not help the use of color. Our visual system can not
use the color information to distinguish small details. To see small details (finely cut
curves, narrow ditches, small steep on curve, green dot on yellow background, etc.) use
vision system only of black and white information. Printing technology with rasterization to create colors
further degrades the contrast of details other than black.

The benefit of color arises only in the stage that the visual system has with its black and white channel set
and recognized the sign.

Example: The new map sign with green balls on a yellow background can be difficult to read
the speed of the black and white reflectance on yellow and green is equal.

Example: IOF's reference color for brown is dark. Much darker than the brown we are looking at
monitor or on cheap home prints. If the map is printed with the correct IOF color
at high-quality printing, it becomes extra difficult to detect small slopes on the fly. They flow together
with the curves.

Explanation of the model

What is orientation for everyone?

The model assumes that the map scale must be suitable for at least 95% of the potential practitioners; not just for the most fit, or for those with the best eyesight. The 2.5% with the best vision and the 2.5% with the worst vision are removed from the model.

If the map cannot be read, the flow disappears and then the character of the branch is lost. A readable map is more important than the size of the map or the number of map changes. Only with a readable map is orientation really fun. A readable map is orientation for everyone.

The differences in eyesight should not be decisive in competition.

In each competition class and open class, a map scale / map readability is selected that is calculated to be good enough for everyone in the class for which the course is intended. The right scale depends mainly on age.

Background facts on synergonomic calculations with CIE RVP

Synergonomy as a systematic science has its background in World War II and that Cold War. It was important to understand the limits of our eyesight.

Researcher Weston conducted extensive systematic research of how in the 1940s readability is affected by luminance (brightness), contrast and symbol size / line width. Other famous researchers such as Blackwell, Oulette, Rea, Silverstein, Adrian, Gibbons, Bailey, Lerman, Boettner, Weale, Verriest, Muck, Bodmann, Simonson, Brozek, McNelis, Loe, Waters, Shapely continued to research the subject for the following decades. Bl.a. Blackwell and Sale developed mathematical models. Over the years, the data and the theoretical ones were expanded the models to also include the effect of age on eyesight.

Weston's original research was done with so-called Landolt rings, which fits well with that in mind orientation and analysis of small map characters and elevation curve details, respectively. In the sequel the research also used other objects and the results are considered universal.

In the late 1990s, the CIE decided to set up an expert committee to review research results. The work resulted in a consensus model that correlated well enough with previous models and research data. The model was published in 2002 and has received standardization ID CIE 145: 2002.

The CIE RVP (relative visual performance) model calculates the relative read speed as function of:

• Light (medium luminance)
• Contrast
• Line width and symbol size defined as space angle
• Age

The best reading speed that can be achieved is 100%. When conditions are good enough achieved 100%. If the conditions are better than that, the reading speed will not improve. The purpose of the synergonomic model is:

• To give an assessment of how much the ability to see during orientation deteriorates age.
• To show how much the visual acuity varies within the age group.
• To help develop orientation to a sport that everyone can have fun in without special aids.

CIE RVP does not take a position on dynamic visual acuity, ie the eye's ability to read objects moving or the ability to adapt to reading objects that vibrate. For this special cases, which are important in many sports, so far there are none universal numerical calculation model. So we can only consider it in one approx.

CIE RVP needs to know line width and symbol size as a space angle. The angle of space can calculated as a function of the size in millimeters and the reading distance in millimeters. Since reading distance increases with age, so this parameter becomes of central importance and must calculated accurately.

For SOFT's working group, the smallest detail was used: 0.15 mm in the basic scale 1:15 000. Magnification at another scale. The space angle was calculated in accordance with the respective age group reading distance.

The contrast can be calculated if you know the (black and white) reflectance of the sign and its background. The IOF has not determined an exact value for the reflectance. Neither RGB, CMYK or PMS are exact definitions of reflectance. If the CIELAB values of the color are known, the reflectance is calculated. Otherwise it should be measured. In practice, measurement is needed, because the properties of the paper have a great impact on the reflectance.

For SOFT's working group, a spectrophotiometer with SCE geometry was used to measure the reflectivity of the colors of the IOF offset reference print issued by the IOF office. The contrast value 0.28 was used in the calculations. Contrasts around 0.28 are available for several color combinations. On maps printed on print other than offset, the contrast can be worse.

The light (medium luminance) depends on the illumination level (lux) and the colors on the map. The light depends on the season, time and weather. The color of the map was assumed to be light with predominantly white background.

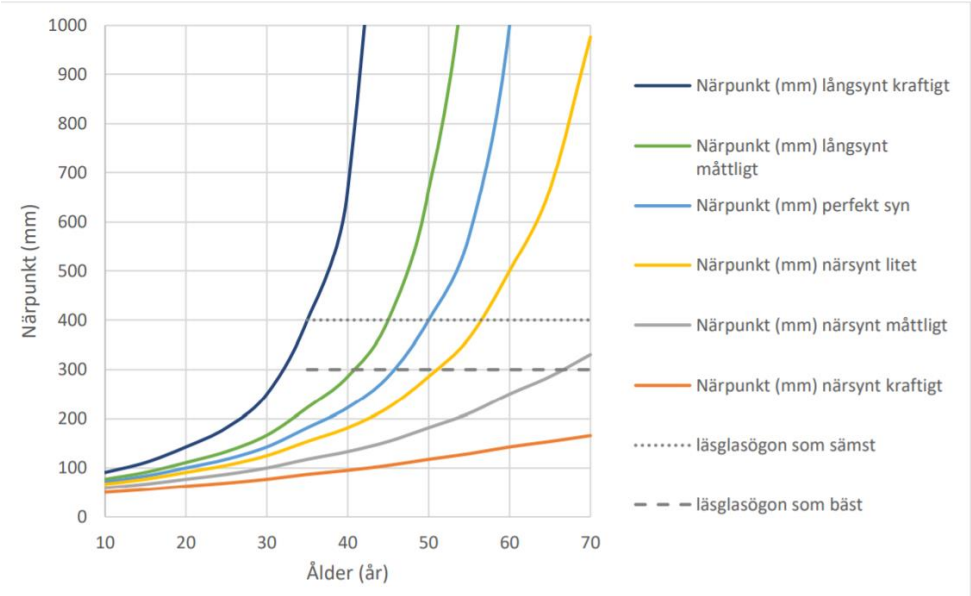
In the calculations for SOFT, 10,000 lux was used as a calculation basis. A value that is right common in the forest during the summer. In the autumn and in the evenings, however, the lighting can be as little as 2,000 lux.

The age was calculated over the entire scope that CIE's RVP model supports: 20-85 years.

Additional calculations

The calculation model enables fast and accurate calculations of many different ones eventualities and situations. The model is especially useful for producing relative differences between different situations, e.g. in connection with the development of regulations and kartnorm.

Reading distance and near point



Narpunkt (mm) = Nearpoint (mm) Alder (ar) = Age (years)
Närpunkt (mm) långsynt kraftigt= Near point (mm) long-sighted strongly
Närpunkt (mm) långsynt måttligt= Near point (mm) farsighted moderately
Närpunkt (mm) perfekt syn= Near point (mm) perfect vision
Närpunkt (mm) närsynt litet= Near point (mm) nearsighted small
Närpunkt (mm) närsynt måttligt= Near point (mm) nearsighted moderate
Närpunkt (mm) närsynt kraftigt= Near point (mm) nearsighted strongly
läsglasögon som sämst= reading glasses at their worstläsglasögon som bäst= reading glasses at their best

The nearest point is the shortest distance at which you can see clearly. It is possible to work for a while the natural near point. To avoid eye fatigue, when working longer it is recommended not to use a distance shorter than twice the natural near point.

The near point changes as the eye gets older because the eye's accommodation capacity decreases. This compensated with reading glasses or progressive glasses. Normally, glasses are sharpened to get an artificial one
near point between 300 and 350 mm. At older ages, the depth of accommodation decreases and with simple reading glasses you only get a fixed viewing distance. Therefore, progressive glasses are increasingly used and
therefore, age glasses are not normally worn for shorter distances than 300 mm.

Especially between the ages of 40 and 55, the near point changes rapidly. Even if you bought glasses with close point 300 mm the close point grows quickly and it is not expedient to frequently buy new ones glasses. With regard to orienteering maps, it is therefore relevant to assume that participants are over 50 years of age
has a near point between 300 and 400 mm. At younger ages, not everyone wears glasses. That is why we should leave
from the participants' near point can be up to an arm's length.

The analysis for orienteering is based on the idea that orienteering should be fun for everyone without it special aids, such as contact lenses in one eye or progressive glasses specially sharpened only for orientation. In the age group 40-50 years, there are people who in their daily lives manage without glasses despite
that their near point is already around 400 mm or even slightly longer. If everyone is to be able to participate, ”come
as they are ”, and have fun, the map scale in the age group 40-50 years should also work for one viewing distance of 400, even 500 mm.

RVP calculations

Below are RVP calculations as described above. Calculations have been made for the most common scales, as well as for current regulations and the proposal for new regulations.

2.5% and 97.5% should not be taken literally.

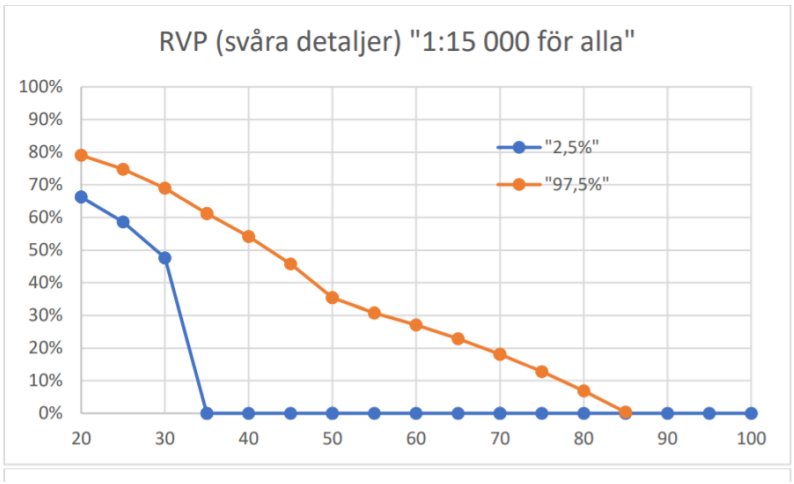
In ergonomics, you choose for how large a part of the target group one is
work is done. This work has been done with a goal of covering 95% of the target group. It would then mean that the 2.5% with the worst vision, and the 2.5% with the best vision, fall outside the calculations. In the work, guideline values and parameters have been chosen according to 95% of the target group. However, the reader should remember that
the person behind the calculations and the model does so completely non-profit and voluntarily - and with limited resources.

The goal for the work is 95 percent accuracy. However, not all details have been verifiable
with that accuracy.

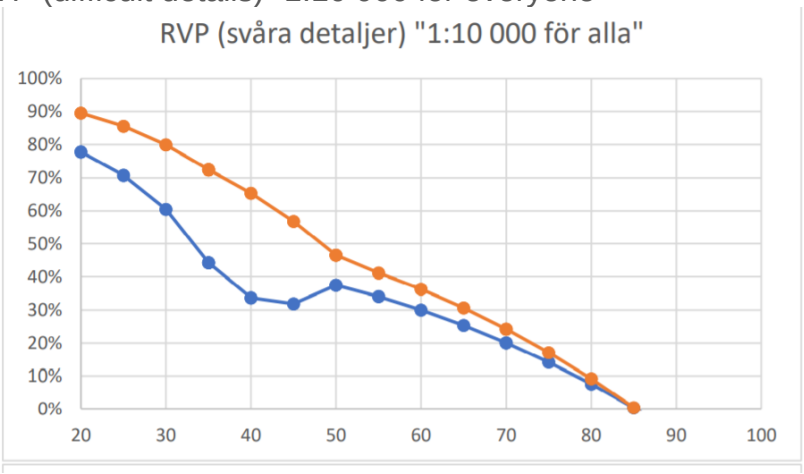
Concluding remarks

There is no doubt that the changes proposed by the working group would significantly improve the availability of the orienteering and the “fun factor” for a significant number of middle-aged orienteers. The details can be disputed. However, it is hardly effective to during the dark season of late autumn and winter conduct theoretical discussions that cannot be evaluated in the real environment. More benefit can be achieved by implementing the good proposal and during the 2019 season make systematic follow-up lasting of both gallup to participants and organizers as well as statistical analysis and technical measurement of the printed map quality.

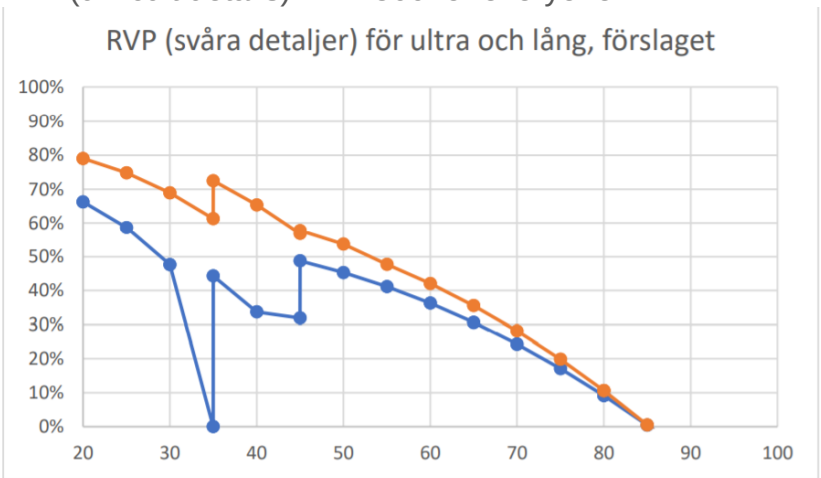
RVP (difficult details) "1:15 000 for everyone"



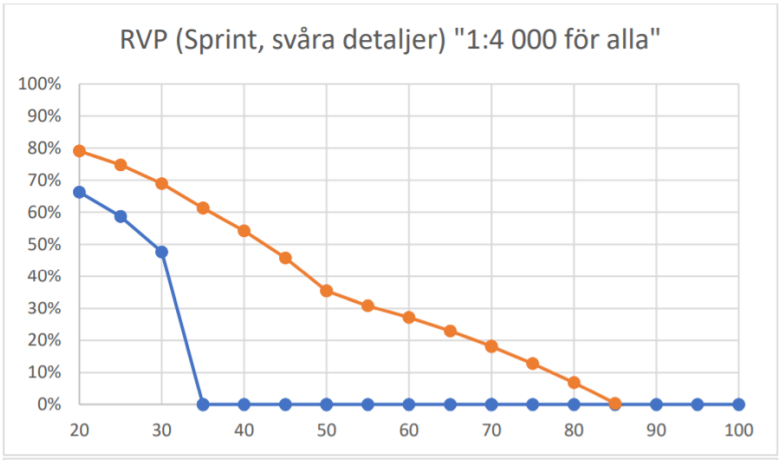
RVP (difficult details) "1:10 000 for everyone"



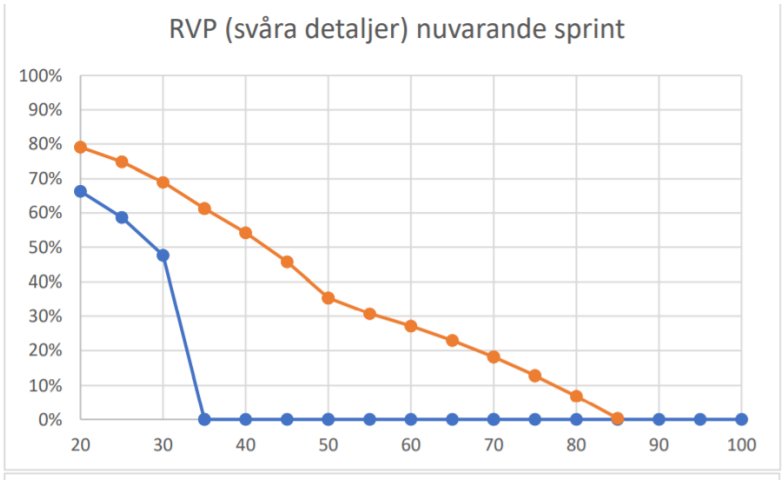
RVP (difficult details) "1: 7 500 for everyone"



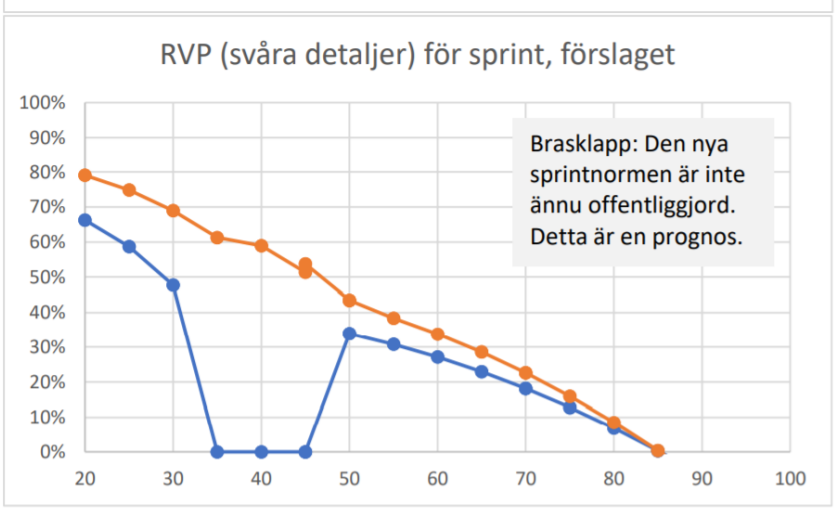
RVP (Sprint, difficult details) "1: 4,000 for everyone"



RVP (difficult details) current sprint

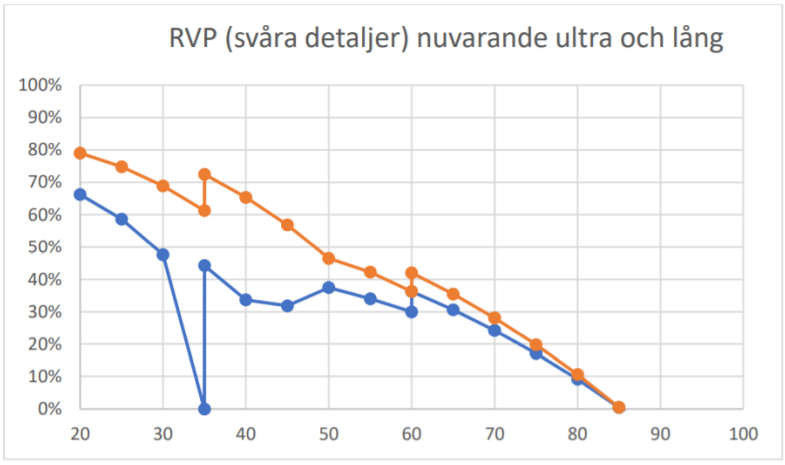


RVP (difficult details) for sprint, the proposal

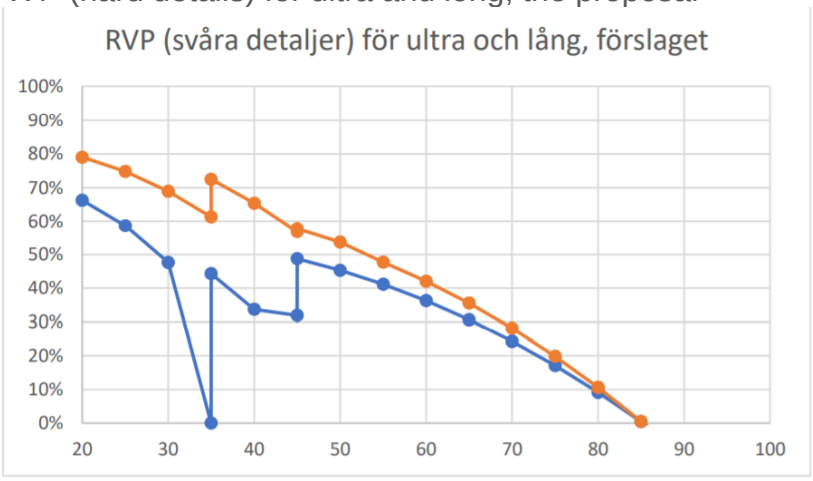


Brasklapp: Den nya sprintnormen är inte ännu offentliggjord. Detta är en prognos.
Fireplace: The new one the sprint norm is not yet published. This is a forecast.

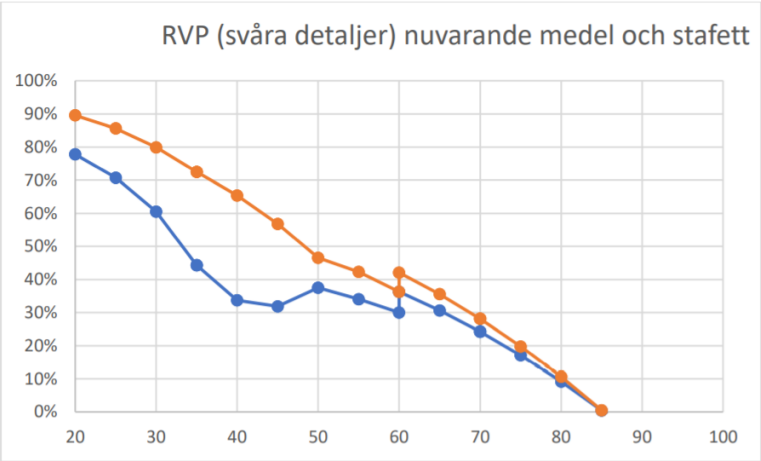
RVP (difficult details) current ultra and long



RVP (hard details) for ultra and long, the proposal



RVP (difficult details) current middle and relay



RVP (difficult details) for middle & relay, the proposal