
TSG Meeting May 2003

Progress Report

By The TSG Ranking Subgroup

Introduction

The purpose of this report is to record progress made by the TSG Ranking Subgroup, who met on 21 November 02 and 10 April 03 at TRL.

The subgroup was formed by the TSG to consider problems identified with condition ranking, and to suggest ways in which this part of UKPMS might be improved. The Terms of Reference for the subgroup, which were agreed at the TSG meeting on 18 February 03, are given for reference in Appendix A.

The subgroup has listed all problems reported with condition ranking. These are summarised below in this report, and are given in full in the Catalogue of Problems (Appendix B). This list will help us to decide which areas of condition ranking should be addressed, and to determine which solutions offer an improvement.

Our suggestions for improvements are centred on a toolbox approach. This offers a route to immediate improvements, and also paves the way for longer term developments which could be provided in due course. We consider that it may be helpful to produce an Advice Note to explain how to make best use of condition ranking, and to warn users of some of the problems they may encounter, and how to counter these. The framework for the Advice Note is given in Appendix C.

During our discussions in the subgroup we have identified issues which are inextricably linked to the development of condition ranking. These are concerns about whether this part of UKPMS is being used currently, and if it is not, to try to find ways to help users to make full use of this part of UKPMS. The second important issue is a need to obtain funding for the work to be progressed further; all three subgroup members can only devote modest amounts of time to the work and cannot undertake the detailed analysis and investigation required for full implementation of the changes.

Finally the report outlines the on-going work which includes a trial of real data and a presentation of the findings of the group to encourage a dialogue with users.

Problems with Condition Ranking

We have categorised the problems as either ‘Technical’ or relating to ‘Usability’, and in summary we have the following:

Technical

- Minor treatments ranked more highly than major
- Multiple treatments ranked inappropriately
- Treatments with zero ranking
- Treatments starting with a ranking greater than zero
- Overall condition index calculation
- BVPI defect lengths can have a zero ranking
- Clustering of defect lengths

Usability

- Lack of confidence and understanding
- Condition ranking is restricted to comparisons within the same treatment (ie cross treatment comparisons are not advised)

The list of problems is explained in full, with examples, in Appendix B (Catalogue of Problems).

Suggestions

Our suggestions for improvements are centred on a Toolbox approach, which is explained below. We have considered how this approach may be used to provide immediate improvements with very little effort, and how it may also in due course, and after further work, provide the basis for more substantive benefits.

The fundamental aim of condition ranking is to provide an objective 'worst first' list; this has been born in mind during the development of the suggestions.

Toolbox

The elements of the toolbox are:

- 1. Overall Condition Index:** A ranking list in descending order, based on overall condition index.
- 2. Active Condition Index:** A ranking list split by treatment, based on the 'active' condition index for that treatment. So the rankings for the Edge treatments would be the edge condition index (in descending order).
- 3. Condition Ranking Curves:** A more sophisticated condition ranking, similar to the existing condition ranking approach but overcoming any flaws in the current approach. If possible this should be achieved by changes to the Rules and Parameters, rather than by a completely new approach or changes to the UKPMS processing logic.

Immediate Improvements

New Report

Our suggestion for immediate improvements is to encourage developers to provide a report to list defect lengths in descending condition index order, for any specified condition index. We would also suggest that the report should be able to be filtered to give just those defect lengths with a single specified treatment, when required. This report, when used for the overall condition index, will provide a proxy for element 1 of the toolbox (ranking using overall condition index) although at this stage we just envisage a simple report rather than a new alternative ranking. The report would also offer an approach for element 2 of the toolbox (ranking using active condition index), if we supply information linking each treatment to an 'active' condition index.

Note that this simple report would help us to decide if these elements of the toolbox show promise, by proving their usefulness with real data before introducing them as alternative ranking options. Very little work would be required of developers, other than producing a straightforward

report. We would need to publish advice linking treatments to condition indices so that when filtering by treatment users would know what the active condition index for that treatment is.

A major limitation of this approach are that this simple report would not be a fully fledged alternative ranking and so could not be used as a basis for UKPMS Budgeting. A second limitation is that the link between treatment and active condition index would be simplified; some treatments are triggered by the levels of two condition indices and this would not be catered for.

Advice Note

A second suggestion which would offer immediate benefits would be to produce an Advice Note about condition ranking. The purpose of this would be to encourage users to use condition ranking and to explain how the process works. It would also point out any pitfalls, and would help to ensure that users are aware of any situations where ranking should be interpreted with caution. This Advice Note could introduce the proposed Toolbox approach and would specify the suggested report described above. The intention is that the Advice Note would begin to address the concerns we have identified with Usability (see Appendix B Catalogue of Problems issues 8 and 9), and would begin a dialogue with users about condition ranking. We would encourage developers to build on the UKPMS Advice Note in order to provide advice which is tailored to reflect their own systems. A possible framework for the Advice Note is given in Appendix C.

These immediate improvements do not solve any of the fundamental problems with condition ranking but they do increase awareness of condition ranking and allow both developers and users to begin to explore alternatives without incurring major expense.

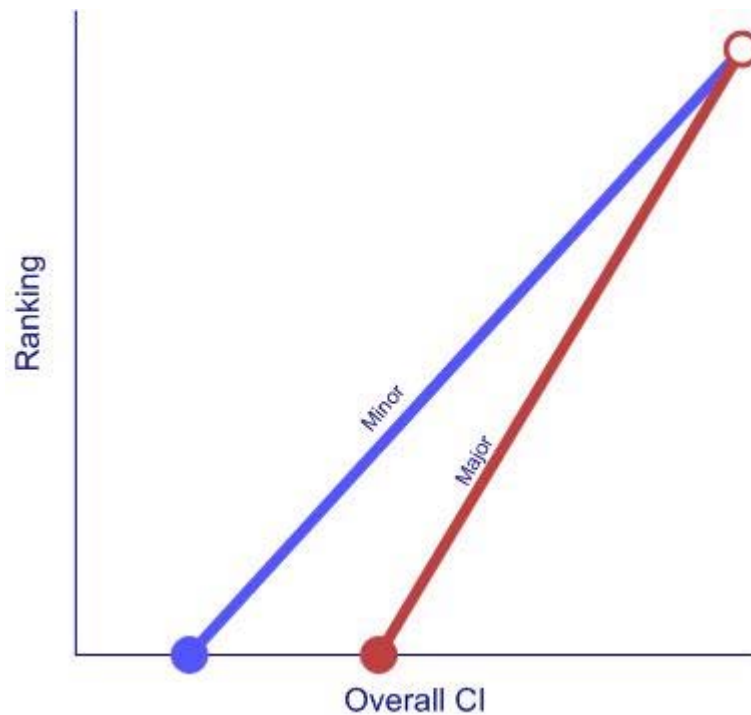
Longer Term Solutions

Before introducing any longer term solutions more extensive analysis and testing work is required; this is the main reason why these solutions cannot be implemented in the short term. At the moment they are proposals for further investigation, and this investigation may lead to them being amended prior to implementation or dropped.

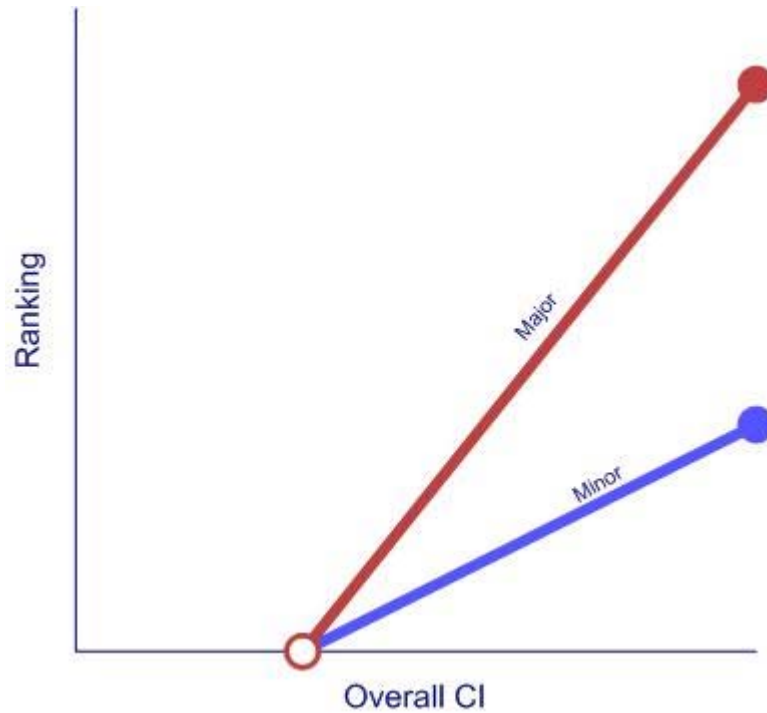
The longer term solutions will inevitably have some impact on developers, although this will be kept to a minimum. It will therefore be essential to consult on the implications prior to making any firm recommendations.

The longer term solutions are tied to the Toolbox approach, and are described within that framework.

1. **Overall Condition Index:** If the overall condition index does provide a helpful way of ranking defect lengths, then this could be offered as an alternative ranking. This would enable this type of ranking to be used for UKPMS Budgeting. Note that prior to using the overall condition index in this way we may need to review the Rules and Parameters to ensure that the overall condition index is calculated in a way which best suits user requirements.
2. **Active Condition Index:** If it is useful to rank defect lengths based on the active condition index for their treatment then we could integrate this idea more fully into UKPMS. We may need a Rules and Parameters table to tie each treatment to a condition index, or we may develop logic rules to allow the active condition index to be determined from the treatment rule. As for the overall condition index, this approach could be offered as an alternative ranking so that it can be used as the basis for UKPMS Budgeting.
3. **Condition Ranking Curves:** Currently all ranking curves consist of a straight line between two points, and the second of these points is always (100,100). We could change the Rules and Parameters so that the first point is fixed (perhaps the lowest intervention level which triggers any treatment?) but vary the second point. This would ensure that the ranking curves for more severe treatments always generate a higher ranking. It would also remove the problem of zero rankings. This idea is illustrated by the diagrams below:



Existing approach to Condition Ranking Curves



Proposed approach to Condition Ranking Curves

Although more analysis would be needed to decide if this solves all the problems this seems a promising suggestion to explore. Funding will be needed to study this in detail, first to see if it provides an improvement and secondly to determine new Rules and Parameters. An advantage is that this would not require developers to make any logic changes; the change would be contained within the Rules and Parameters. A possible extension to this idea would be to vary both the first and second points. If neither of these two ideas bear fruit then simply adding a constant to all ranking values would (artificially) avoid the anomaly of zero rankings for defect lengths with treatments.

Issues

User Interest

Although the existence of the subgroup has been well publicised we have received relatively little interest from users or from other developers. Currently their concerns are with other areas of UKPMS.

We think that this lack of input may be due to several factors.

- Many users are driven almost entirely by the need to produce BVPIs and their use of UKPMS stops at this point. Any operational information derived from UKPMS tends to focus on BVPI results, that is those sections which contribute to the BVPI. This means that condition ranking is bypassed.
- If users do consider condition ranking and are dissatisfied with the results then they may avoid this part of UKPMS in the future or find a workaround which doesn't involve condition ranking, rather than contacting the subgroup or developers with their concerns.
- CVI surveys are widely recognised as being coarse and subjective. Users therefore do not expect condition ranking to discriminate accurately based on this input data; so some of the deficiencies in condition ranking may be blurred by the coarse input data. As machine surveys are used more extensively then users may begin to be concerned that even with objective data, condition ranking has quirks.

It is difficult to judge if this part of UKPMS is worthy of development resources. If it is surplus to requirements then perhaps it should be shelved with a 'health warning' for the time being. Alternatively it might be that it is only by making improvements to this area that it will be relied on as a useful part of UKPMS.

Funding

No UKPMS funding for work on condition ranking is available as yet and so all three subgroups members are currently being funded by the organisations they represent (MARCH, Hertfordshire CC and TRL). Naturally there is a limit to the amount of work which can be carried out on a voluntary basis such as this. If the work is to proceed then it is vital that a source of funding is identified. One suggestion is that when the UKPMS Support Consultant is appointed we could hand over our findings for further development; the subgroup could be retained for consultation and would be happy to represent the TSG on this project. Alternatively if direct funding can be obtained then we may be able to take a more active role ourselves.

Current Initiatives

Real Data Trials

Hertfordshire have offered to provide data for some trials. The purpose of these would be to look at the ranking order produced by the current condition ranking algorithm and compare this with ranking orders obtained using the overall condition index or the active condition index. We hope to relate these results to the list of defect length which contribute to the BVPIs and so establish how the ranking can be improved. This data set will illustrate some of the problems listed in Appendix B, and so will help to provide a benchmark to test if our suggestions do improve condition ranking. Clearly this area of work could, if conducted properly, be very time consuming; we will have to take a more modest approach, and try to obtain indicative results within limited time constraints.

We anticipate that we may also be able to carry out similar investigations for other sets of real data, so that we provide a more rounded perspective of the issues.

Workshop

We hope to be able to present our work at an Owners Forum event. This will help to communicate what the subgroup is working on, and will encourage a dialogue with users.

Next Meeting

Our next meeting is to be held on 20 May 03, directly after the TSG meeting.

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May 03

Appendix A: Terms of Reference

The aims of the TSG Ranking Subgroup are:

- To investigate UKPMS condition ranking with a view to identifying any flaws in the current approach.
- To propose improvements to UKPMS condition ranking so that the results are technically sound, and can be used with confidence.
- To ensure that any changes to condition ranking have a minimal impact on developers and on any historical data, whilst still rectifying the identified flaws.
- To identify ways to communicate the UKPMS condition ranking approach so that it is more widely understood and more useful.
- To ensure that UKPMS condition ranking results complement the BVPI results, but without constraining condition ranking by this specific application.

Note that the subgroup plans to restrict its work to condition ranking; it does not intend to address economic ranking.

These Terms of Reference were agreed by the TSG on 18 February 03.

Appendix B: Catalogue of Problems

This Appendix gives the Catalogue of Problems version 3.

Technical

1. Minor treatments ranked more highly than major

- a. The treatment is selected based on the condition indices (often just one condition index). The relevant condition index triggers a treatment when it reaches a trigger intervention level. So more minor treatments are invoked at lower levels of CI, and more major treatments at higher CI levels.
- b. The overall CI is set to be the highest of the constituent CIs, or specified combinations of them. So the overall CI is always greater than or equal to any of the constituent CIs.
- c. The ranking curve assigns a ranking value based on the value of the overall CI.
- d. There is a different ranking curve for each treatment (and feature hierarchy).
- e. The ranking curve ‘starts’ at the trigger intervention level. (Although this is believed to be a general principle it is not always the case. – See Problem 3.)

The result of this is that the ranking curve kicks in at a lower level for more minor treatments and at a higher level for more major treatments. And so the ranking curve for the more minor treatment lies above that for the major treatment; for a given Overall CI the minor treatment ranking is always higher than the major treatment ranking. So, the ranking value obtained for a minor treatment may well be higher than that for a major treatment.

An example:

Assume that the feature hierarchy is 4b.

If the WCRSE CI is 70, then the treatment generated is RESUR, the overall CI is 70, and the ranking is 0 (Since the WCRSE ranking curve starts at 70)

If the SRPRP CI is 70, then the treatment generated is SURIMP, the overall CI is 70, and the ranking is 50 (Since the SURIMP ranking curve starts at 40).

2. Multiple treatments are ranked inappropriately

- a. A multiple treatment will generally be the result of two non-zero CIs.
- b. The overall CI is greater than or equal to either of these CIs.
- c. There will be two possible ranking values (one for each treatment). The ranking used is the higher of the two.

The result of this is that the ranking used (ie the highest obtained) is from the treatment with the lower trigger intervention level, but the overall CI will be set to at least the higher trigger intervention level. This results in a higher ranking than expected.

An example:

If the Edge CI ≥ 70 and the SRPRP CI ≥ 40 , then the treatment generated is SURIMP & EDGE/PARCON.

The overall CI is at least 70 (as the Edge CI ≥ 70).

The EDGE treatment ranking curves kick in at 55-70 (depending on feature hierarchy) and the SURIMP ranking curve kicks in at 40. So, for a given Overall CI the SURIMP ranking curve will always give the higher ranking value (as its curve will always lie above the EDGE curve).

Since the Overall CI ≥ 70 , the ranking obtained is ≥ 50 (from the SURIMP curve). So, this multiple treatment is always ranked as at least 50.

3. Treatments can have a zero ranking

- a. The ranking curve does not always ‘start’ at the trigger intervention level.
- b. If the ranking curve starts at a higher CI than the trigger for that treatment then the ranking for the treatment is zero.

The result of this is that a treatment can be generated, but have a ranking of zero.

An example:

If the Wcrse CI ≥ 25 then a RESUR/PATCH treatment is generated (for any feature hierarchy). However, the ranking curves start at 55 (2 and 3a), 60 (3b), 65 (4a), 70 (4b). Assume that the Overall CI is equal to the Wcrse CI (which is so if the other CIs are small). So, if a section is of hierarchy 3a and has a Wcrse CI of 50, then the ranking will be zero.

Moreover, since a higher treatment (RESUR/OLAY or RESUR/INLAY) starts at an intervention level of 50 (for feature hierarchy 2), 60 (for 3a and 3b) or 70 (for 4a and 4b), any RESUR/PATCH treatments on hierarchies 2, 3b or 4b will always have a zero ranking. These findings are summarised in the table below:

Feature hierarchy	Ranking curve start	Worse CI for RESUR/PATCH	Notes
2	55	25-50	Ranking is always zero.
3a	55	25-60	Only those with a CI from 55-60 have a non-zero ranking.
3b	60	25-60	Ranking is always zero.
4a	65	25-70	Only those with a CI from 65-70 have a non-zero ranking.
4b	70	25-70	Ranking is always zero.

4. Treatments can start with a ranking greater than zero

- a. The ranking curve does not always ‘start’ at the trigger intervention level.
- b. If the ranking curve starts at a lower CI than the trigger for that treatment then the ranking for the treatment starts at a level greater than zero.

This is related to Problem 3, and in fact may not be a problem but just a characteristic of the ranking process. Higher treatments, within the same generic treatment, may start with a ranking greater than zero.

An example:

The intervention level for the Worse CI to trigger RESUR/OLAY or RESUR/INLAY is 50 (2), 60 (3a and 3b), 70 (4a and 4b), and these trigger intervention levels do not always match the ranking curve start point. The table below shows some of the implications of this.

Feature hierarchy	Ranking curve start	Worse CI for RESUR/OLAY or RESUR/INLAY	Notes
2	55	50	50-55 has RESUR/OLAY or INLAY treatment but ranking of zero.
3a	55	60	60 triggers a RESUR/OLAY or INLAY treatment and the ranking is immediately 11.
3b	60	60	The ranking starts at zero.
4a	65	70	70 triggers a RESUR/OLAY or INLAY treatment and the ranking is immediately 14.
4b	70	70	The ranking starts at zero.

5. Overall Condition Index calculation

The overall condition index is calculated as the highest of any of the following components:

- Any of the individual CIs
- Certain combinations of CIs

For example the Overall CI for BTCC pavements is calculated as the highest of the following:

- 1 x EDGE
- 1 x SRPRP
- 1 x STRUC
- 1 x WCRSE
- 0.55 x STRUC + 0.55 x WCRSE
- 0.55 x SRPRP + 0.55 x WCRSE
- 1 x STRUC + 0.1 x EDGE
- 1 x WCRSE + 0.1 x EDGE
- 1 x STRUC + 0.1 x SRPRP

This shows that a defect length with a high surface properties condition index (SRPRP) can have the same overall condition index as one with a high structural condition index (STRUC). The calculation assigns equal importance to each of the four individual condition indices.

6. BVPI defect lengths can have a zero ranking

A defect length can contribute to the BVPI results, yet have a zero ranking.

For example: Suppose the Wearing Course CI is 60. Then the defect length will contribute to BVPI 97. However, if the treatment triggered is RESUR and the feature hierarchy is 3b, 4a or 4b then since the ranking curves start at 60 or above, the ranking will be zero.

The same effect occurs for the footway BVPI 187. Here if the footway is bituminous and has an overall CI of between 50 and 55, then the treatment will be RESUR and the ranking will be zero (for hierarchy 1 or 1a). Such footways will contribute to BVPI 187.

7. Clustering of defect lengths

Condition ranking does not discriminate well between defects lengths, and so many defect lengths have the same ranking (often 100). During the UKPMS Budgeting process defect lengths are assigned for funding in an order based on Ranking, followed by Section Label. When many defect lengths have the same ranking then some of these defect lengths may be funded while others are not, with the decision being based on the Section Label.

For example: Suppose two sections have condition indices and rankings as given in the table below:

Section Label	A/005001/010	A/006123/090
Edge CI	0	90
Srprp CI	0	0
Struc CI	93	93
Wcrse CI	93	93
Ranking	100	100

Here since both sections have the same ranking, A/005001/010 may be funded while A/006123/090 is not, due to the section label order. However a true ‘worst first’ condition ranking order would fund A/006123/090 rather than A/005001/010 due to the difference in the edge CI.

Usability

8. Confidence and Understanding

There is a problem with the existing approach to condition ranking because many users do not understand how the ranking is calculated and do not have confidence in the results. This is exacerbated by the technical problems described above. In particular the fact that a defect length can contribute to the BVPI results, and yet have a zero ranking is confusing. Clustering of results is also a concern and undermines confidence in the use of ranking, especially for UKPMS Budgeting.

The condition ranking should be explained carefully so that users understand how it is best used. For example, the term ‘worst first’ should not be used if the algorithm produces an order which is not based purely on condition.

If the algorithm is documented accurately and communicated through a variety of channels then this will help users to understand both its potential and its limitations, and will help to ensure that it is used with confidence and understanding.

9. Comparisons across treatments are not advised

Although UKPMS purports to give the ability to compare rankings across different treatments, at least one developer feels that this is not possible. They advise their users in training sessions that rankings are only a means of prioritising within a treatment.

Since the UKPMS budgeting process is based on rankings, the advice not to attempt to compare rankings across treatments implies that each budget head should be restricted to a single generic treatment.

Appendix C: Advice Note on Condition Ranking

We suggest that an Advice Note on Condition Ranking should be issued and that it should include the following points:

- An explanation of condition ranking. How rankings are calculated and how they are used.
- Issues to be aware of.
- Pitfalls (obtained from the Catalogue of Problems) and how to deal with these.
- The Toolbox approach
- A suggested report, giving defect lengths in descending condition index order (for a specified condition index). This report should be able to be filtered by treatment.
- A list mapping treatments to active condition indices for use with the above report.
- Encouragement for developers to produce their own advice, tailored to their systems, and building on the UKPMS Advice Note.
- A contact point for feedback (the UKPMS Support Team, and the TSG Ranking subgroup members).