



Arlinger John

27 November 2023

Minutes StanForD

2023-11-27

Place:	Uppsala/Teams, 2023-11-22, 09:00-15:00 CET
Participants:	John Arlinger, Secretary Johan J. Möller, Chairman Fredrik Tjernberg, Komatsu Jeremy Gibson, PHD Forest Ian Wilson, PHD Forest Hans-Ulrich Dietz, University of Freiburg Antti Korkiakoski, JohnDeere Anders Rowell, Skogforsk Aapo Koskela, Logset Bengt Sörvik, Otmeka Henrik Persson, LogMax Ola Fjellfeldt, LogMax Jonas Gustafsson, Sveaskog Mathias Paulsson, Rottne Tapio Räsänen, Metsäteho Timo Melkas, Metsäteho Mike O'Shea, Coillte Lars-Erik Andersson, Dasa Jonas Hafmar, Södra Jonas Thorsson, Dasa <u>Attending through Teams:</u> Bobby Sz wajkowski, Tigercat Erik Kindlund, JohnDeere Jaakko Mäkinen, Technion Juha Korhonen, Technion Jyrki Vainio, Trimble (afternoon) Komulainen Heikki, Ponsse Lars Henriksson, Biometria Louis-Vincent Gagne, FP Innovation Magnus Hansson, SP Maskiner Pursiainen Janne, Ponsse

Decision summary

Decided to do the following schema updates:

- It was thus decided that the following two new enumerations are added to schema version 4.1: "PPP RTK Fix" and "PPP RTK Float".
- It was decided that the data type of DegreeType is changed from nonNegativeInteger to nonNegativeDeciaml with version 4.1.
- It was decided to postpone the proposal for reporting of stem pile data from feller bunchers.
- It was decided to make FelledStemCoordiantes repeatable to make it possible to register both BaseMachine and Attachment center when stems are laid down on the ground.
- It was decided to publish the forest regeneration production schema (rpr) at the web site (www.skogforsk.se/stanford) as PreRelease version 4.1. It was also decided to postpone the final decision until some manufacturer has done a test implementations of the PreRelease version of the new schema for ForestRegeneration. The secretary will communicate the updated proposal with the known manufacturers of planting and site preparation equipment (Risutec, Plantma, Bracke and M-Planter).
- It is suggested with the minutes to recommend that the enumeration value "None" is registered in attribute "barkFunctionCategory" in cases when converting bark parameters from version 4 to version 2 and 3.
- It is suggested with the minutes that we recommend the use of one Unclassified product per species and that it would be an advantage to use the existing SpeciesGroupKey in the UnclassifiedProductDefinition.

Conclusions from discussions:

- Further testing of new methods for reporting unloaded logs (identities and positions) will be carried out. Proposal to be discussed further at upcoming meetings.
- New structure MultiTreeControlData for registering control data for multi tree handling. To be discuss at upcoming meetings.
- The ogr-message is probably the most suitable future format for adding different types of "points of interest" (POI) rather than trying to extend the use of stem codes.
- The next step in developing the proposed new RelativeLimitationMatrix is to run a practical test in a Ponsse harvester. This is to be done before deciding on a standard update.

- The issue of having a separate fuel report per object from forest machines will be discussed further at a separate meeting arranged by Metsäteho. A concrete proposal to be discussed at the next meeting.
- The next wood value test (i.e. harvester test) will probably be carried out in the spring of 2025. The main focus will be on version 4 but it will not be a requirement in order to participate.

Action list:

- It has been noted that DiameterMeasuredStartHeight is always 0 cm in several controllers. It is recommended that DiameterMeasuredStartHeight should be identical with:
 - ButtEndProfileExtrapolation.ReferenceHeight (e.g. 130 cm) if ButtEndExtrapolationFunction is used
 - OR
 - ReferenceDiameterHeight (e.g. 93 or 111 cm) if ButtEndExtrapolationFunction is NOT used
- An increased interest in following-up whether the harvester or feller-buncher is using herbicides or fungicides means that it is recommended that element StumpTreatment is implemented.
- The following guidelines should be followed when implementing LongTimberDefinition:
 - Must be possible to view and edit LongTimberDefinition in administrative tools.
 - Default value equal to DiameterMAXButt in administrative tools
 - LongLogButtMAX is never to be included in pin-file if value is 0 (it is optional).
 - Value 0 (zero) is to be interpreted as null.
- It is recommended to implement stem codes for both individual trees and groups of trees (so called “sticky registration of stem codes”). Whether the “sticky registration” is trigger by double click or any other operator interaction does not matter.
- Do not mix products and deliveries in forwarder applications.
 - Focus on Deliveries in the UI.
 - Avoid using pin-files since it often creates operator confusion.
- Map interface when creating Locations would be good to avoid incorrect coordinates.

- Coordinates in production files should always be activated by default in all forest machines (especially important after software updates when coordinate registration is commonly lost).

§1 Opening of meeting and agenda

Chairman Johan J Möller opened the meeting.

The agenda was accepted.

§2 Presentation of participants

Presentation of meeting participants.

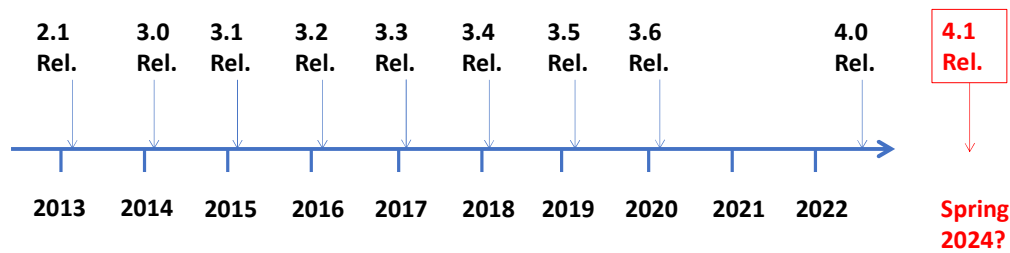
§3 Information about decisions and discussions at previous meetings

Main decisions and conclusions at last meeting (2023-04-24):

- Description of element FillStyle is to be updated in version 4.1. Following enumeration not to be used (deprecated) LightGrayFill, GrayFill, DarkGrayFill and HalfTransparentFill.
- Add new mandatory GISCoordRefSystem attribute also to the background maps (element BackgroundMap) in version 4.1.
- Correct volume and mass types for the fpr schema allowing also negative decimal numbers for partial loads. To be published as soon as possible!
- New element DirsuptedMeasuring to be added in order to indicate that a stem or log has been handled in a way that it is not suitable for measuring control or calibration. For example if a “reversed top sawing procedure” has been used.
- Recommendation when implementing stem codes in harvester controllers:
 - Simple for the operators to move StemCodes up or down in order to have the most commonly used codes at the top.
 - Any change in ordering of stem codes is to be kept permanently.
 - Relevant to register stem-codes also for felled and multi-tree-processed stems.

§4 Future frequency of StanForD updates

The figure below illustrates the timeline for publishing all versions since 2.1.



The secretary stated that it is probably time to do an update to 4.1. during the next year as we now have some significant updates proposed such as coding of features in the ogi and the new log positions and IDs in the fpr-file. The conclusion was therefore that we will have a Teams meeting in February where we go through the proposals and decide on whether to add a new 4.1 version at the meeting in April.

When discussing the time frame for implementation of 4.0 most manufacturers estimates that it will be available on the market by 2025. No concrete implementation schedules were presented at the meeting.

From a data user perspective the most important improvements with 4.0 are:

- New positioning data (e.g. log positions)
- Better and more flexible bark functions

The importance of these improvements has been strongly emphasized by a number of users.

§5 Reporting of issues related to version 4.0

No new errors or bugs to report on.

§6 Proposals for next version 4.1

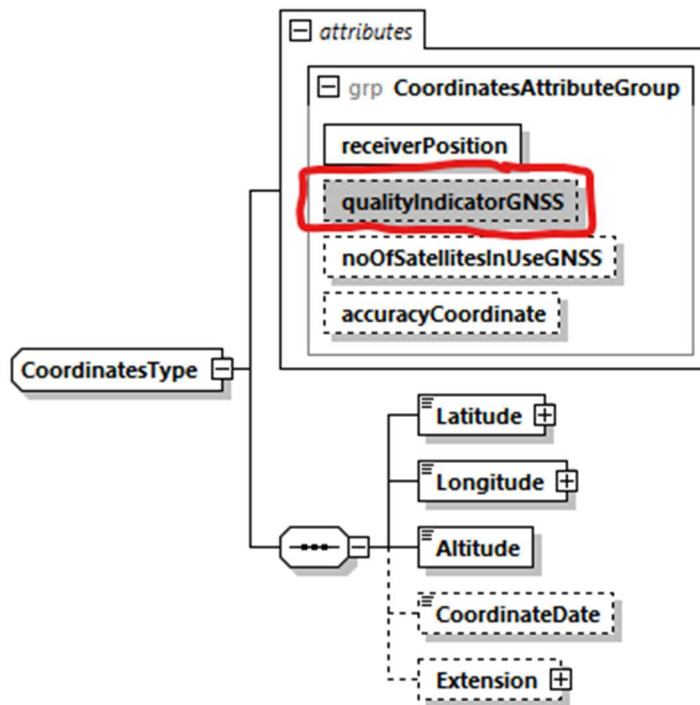
UPDATING ATTRIBUTE QUALITYINDICATORGNSSSTYPE

Discussed at previous meeting 2023-04-25—26 based on question from Fredrik Tjernberg, Komatsu.

Attribute QualityIndicatorGNSS has the following description “Quality indicator of position generated by GNSS receiver. Only need to be registered in case there is a quality change.”. It includes the following enumerations today:

- "Invalid" (No Fix acquired),
- "Normal" (Standard position service, SPS),
- "DGPS" (Differential GPS Fix),
- "PPS" (Precise positioning service fix),
- "RTK Fix" (Real Time Kinematic),
- "RTK Float" (Float Real Time Kinematic),
- "PPP RTK" (Precise Point Positioning Real Time Kinematic),
- "Custom" (not defined, e.g. no GNSS used),
- "Estimated" (Estimated, dead reckoning),
- "Manual" (Manual input mode),

- "Simulated" (Simulation mode). Values Custom and Manual can be used when no GNSS receiver is in use.



Attribute qualityIndicatorGNSSType should perhaps be updated in order to also handle combinations of "PPP" and "RTK Fix"/"RTK Float". It was thus decided that the following two new enumerations are added to schema version 4.1:

- "PPP RTK Fix" (Precise point positioning fix and Real Time Kinematic)
- "PPP RTK Float" (Precise point positioning fix and Float Real Time Kinematic)

UPDATING DEGREETYPE WITH DECIMALS

Discussed at previous meeting 2023-04-25—26 based on question from Fredrik Tjernberg, Komatsu.

"MachineBearingType" is based on the "DegreeType" which is a nonNegativeInteger while "accuracyMachineBearing" is a nonNegativeDecimal. DegreeType probably also could be a decimal value in order to increase precision when registering angles (e.g. BoomAngle, MachineBearing, LogBearing).

<> BoomPositioning	
▲ BoomPositioning	
= boomPositioningCategory	Felling
<> BoomAngle	78
<> BoomExtension	847
▲ <> MachineBearing	
= accuracyMachineBearing	2.23
Abc	23

Decided that the data type of DegreeType is changed from nonNegativeInteger to nonNegativeDeciaml with version 4.1.

REPEATABLE FELLEDSTEMCOORDINATES IN BPR

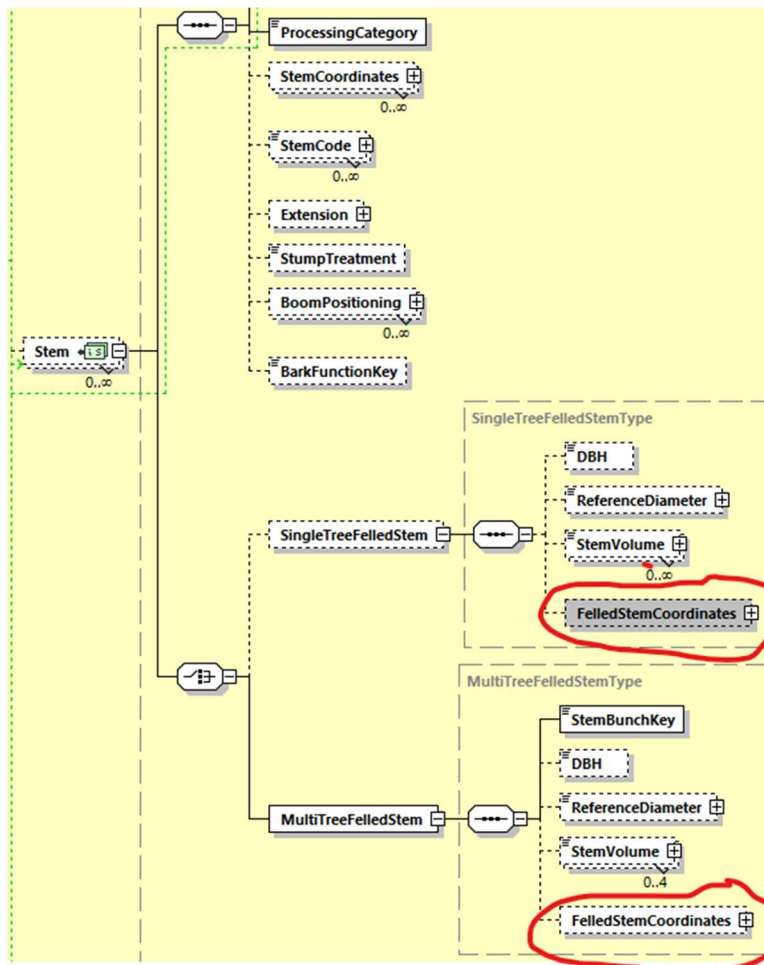
Based on discussion with Ian Wilson and Jeremy Gibson, Forest PHD, 2023-08-10.

The message FelledBunchedProduction includes two different types of stem coordinates as updated 2022-02-08:

- Element StemCoordinates are defined as “Stem coordinates, describes the location of the standing tree.” This element is repeatable.
- Element FelledStemCoordinates is defined as “Coordinates of felled stem. Only used for stems on the ground or in pile”. This element is not repeatable.

It is possible to register either BaseMachine, Attachment center or Product position when stems are laid down on the ground (element FelledStemCoordinates). However, only one coordinate can presently be registered as this element is not repeatable.





It was decided to make FelledStemCoordinates repeatable to make it possible to register both BaseMachine and Attachment center when stems are laid down on the ground. This makes it possible to e.g. register the BaseMachine and Attachment center both when felling (StemCoordinate) and when laying down the stems on the ground. This structure is parallel to the LogCoordinates.

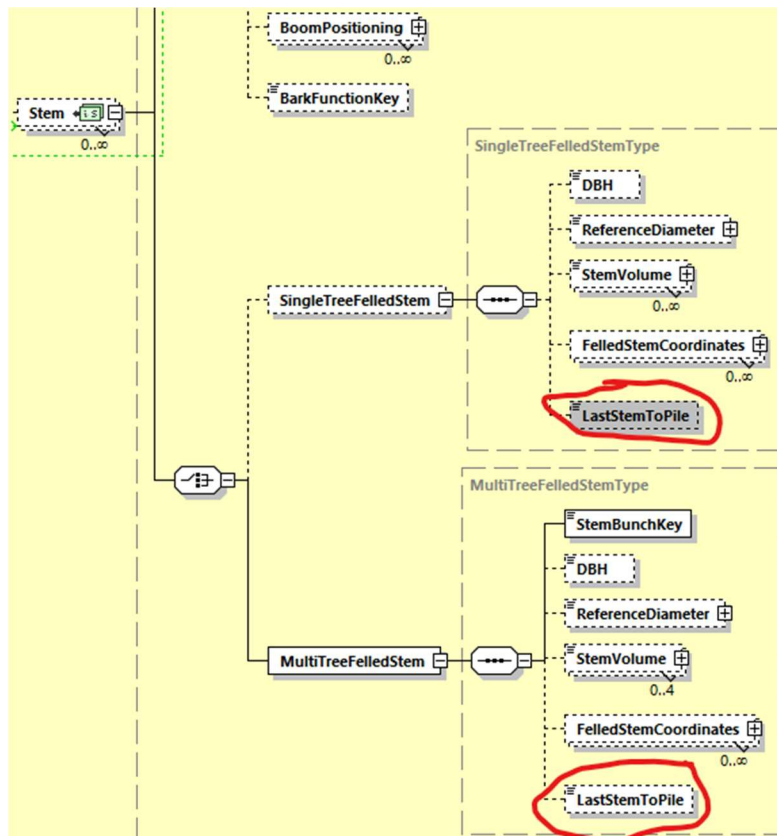
STEMPILES BASED ON BPR (FELLER-BUNCHER)

Based on a discussion with Ian Wilson and Jeremy Gibson, Forest PHD, 2023-08-10.

Several stems are typically laid on the ground together in piles in order to facilitate for yarders and skidders after felling of a tree with a feller-buncher.

Having the operator register once a pile is “complete”/”finished” would be an advantage. Having this information as well as a “Product position” or an “Attachment center” coordinate it would be fairly straight forward to describe the pile position using some type of algorithm.

An idea could thus be to add an optional “LastStemToPile” to the bpr schema.



The proposal was discussed with several different comments and questions being raised:

- This type of manual input by the operator is highly dependent on the operator understanding of how to use such a function.
- It may be problematic in cases where consecutive stems are added to several different piles.
- Exactly how is the data going to be used in the yarder?
- Perhaps better to focus on getting data on the attachment position when putting the stem down on the ground.

The meeting decided to postpone this proposal until a more concrete description of both a use case has been formulated as well as a better description of a relevant user interface. It would probably be an advantage if Dasa and ForestPHD discussed this internally to come up with an updated proposal.

§7 Items for discussion

MECHANIZED FOREST REGENERATION

The secretary presented the present proposal for handling mechanized site preparation and planting (appendix 1).

No major objections or comments were raised with the exception that the secretary should look at the possibility of having a reference from the Tracking to

to Seddling or SitePreparation rather than the opposite (today TrackingKey is included under Planting and SitePreparation).

Another topic was raised by Henrik Persson regarding the fact that there is no coordinate attribute defining what type of event triggers a registration of coordinates. Henrik will prepare some ideas for further discussions regarding an update of the CoordinateType.

The meeting decided to publish the forest regeneration production schema (rpr) at the web site (www.skogforsk.se/stanford) as PreRelease version 4.1. It was also decided to postpone the final decision until some manufacturer has done a test implementation of the PreRelease version of the new schema for ForestRegeneration. The secretary will communicate the updated proposal with the known manufacturers of planting and site preparation equipment (Risutec, Plantma, Bracke and M-Planter).

LOG IDENTITIES IN FPR-FILES AND IMPROVED FORWARDER REPORTING

The secretary presented the present proposal for reporting coordinates and log identities when unloading from a forwarder (appendix 2).

There was a quite long discussion focused on the needs for this kind of detailed reporting, e.g. whether this information is needed if the logs are “mixed up” at a terminal before transporting the logs to a mill. Johan J Möller pointed out that the main objectives in the near term is to facilitate the work of forwarder and truck drivers. Traceability from the forest all the way to the mill reception is more of a long term objective. It was also pointed out by a participant that the costs for generating this type of data is probably quite low if a boom control system is in place in both harvesters and forwarders.

The conclusion was that further testing will be done. It was decided to postpone the decision to the upcoming meetings. Skogforsk is planning to do some testing during the coming months within the project “Digital log traceability”.

REPORT BUTT-OFFS (SHORT LOGS)

This issue was not discussed due to time running out. Will be discussed at the meeting in February.

Background

A similar issue was discussed in 2014-11-20 with a focus on when a stem is to be considered to be processed vs felled. The general conclusion was that at least one classified log must be possible to cut in order to consider the stem as processed and not felled. Short logs were also discussed in conjunction with the implementation of ButtLogMAXStartHeight (2019-11-13).

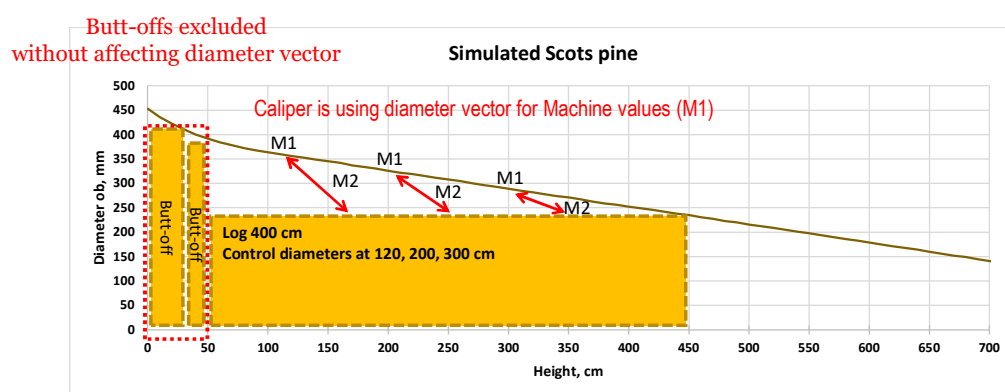
It is stated in the hpr-schema (element DiameterVector) that:

Same values as used in bucking optimisation and calculations of solid volumes. No systematic error when comparing log volumes and volume calculations based on DiamValue.

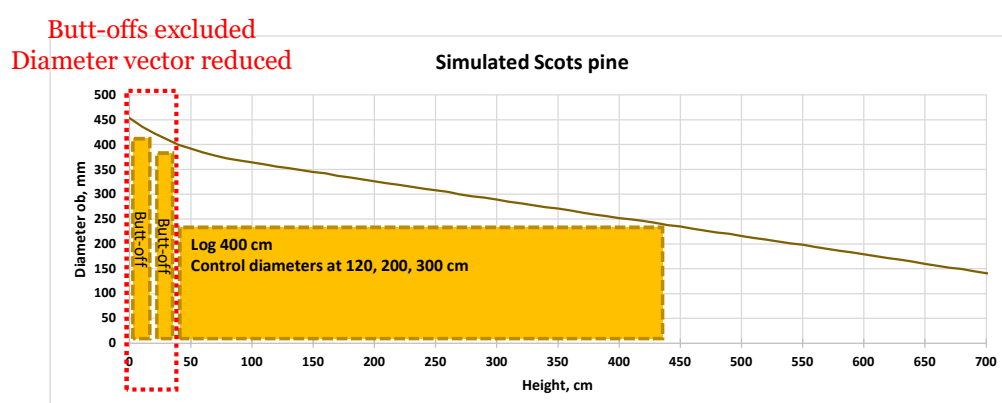
It is possible to set in some systems if a “butt-off” at the butt-end of the stem is to be recorded in the hpr or not. The maximum length for “butt-offs” not being

registered is settable in several controllers. In at least one system the maximum length for butt-offs can be set to 150 cm.

This may cause a problem in a caliper in case of generating an hqc where perhaps the first 50 cm are cut off but not registered as two short unclassified logs. A control diameter at e.g. 200 cm maybe thus be measured at the position of 250 cm from the stump by the operator while the machine measurement is extracted from the diameter vector at 200 cm from the stump. This is illustrated in the figure below.



It is less of a problem for the control measurement in case the diameter vector is reduced in order to exclude the same length interval as covered by the butt-offs.



This issue may also cause systematic errors in case the diameter vector is used for calculating volumes as the following text is included in the definition of the diameter vector (element DiameterValue in hqc- and hpr-schemas):

No systematic error when comparing log volumes and volume calculations based on DiamValue.

The possibility of completely discarding butt-offs is an important issue on markets where the total volume of butt-offs is considered an important quality parameter and especially where it is common to do butt-offs e.g. due to damage caused by skidding or yarding.

Based on the discussion at the meeting the reason for having a setting whereby lengths up to 150 cm seems to be demands on certain markets.

When analysing 600 harvesters with more than 100 000 registered logs in Skogforsk database only one single harvester seems to use a maximum “short log length” larger than 11 cm. Generally speaking, it seems like different brands are using different default values on the Swedish market.

Questionnaire “Butt-offs”

The previous meeting decided to let the secretary send out a questionnaire in order to prepare a proposal or recommendation for the next meeting.

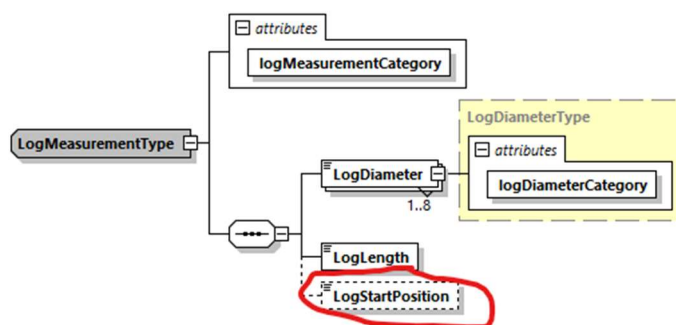
Below is a compilation of the answers

Question	X1	X2	X3	X4	X5
Is the diameter vector reduced (affected) in order to exclude the same length interval as covered by the discarded butt-offs or is the diameter vector unchanged in cases where butt-offs are discarded?	Yes	No	No	Yes	No
Is the length of discarded butt-offs settable in the machine?	Yes	Yes	No, fixed	No, fixed	No, fixed
• What are the maximum and minimum settable lengths?	0-100	0-150	10 cm	10 cm	>0 cm
• Default value for maximum length?		10 cm			
• Different default settings on different markets? (yes/no)	Varies	No	No	No	No
Are all butt-offs discarded independent of where they are cut within the stem? Discarded if butt-off is cut at the top of the stem.	No (only 1 st)	Yes	Yes	Yes	-
What are the consequences if a waste matrix with a minimum length of 20 cm (pin-file) is in use while the machine setting defines that all butt-offs shorter than 30 cm are to be excluded?					
• Are logs between 20 and 30 cm discarded or added to the waste matrix?	Discarded	Discarded	-	-	-
Possible/suitable to add a new element “LogStartPosition” to the hpr per log as it would make it possible to identify stems where short logs have been discarded?	No need	Yes	No	Perhaps but complex	Not needed
Possible/suitable to add a new element “MINRegistrationLength” to the hpr per machine as it would make it possible to identify which short logs are discarded?	Perhaps yes	Perhaps yes	Yes	Yes	Not needed

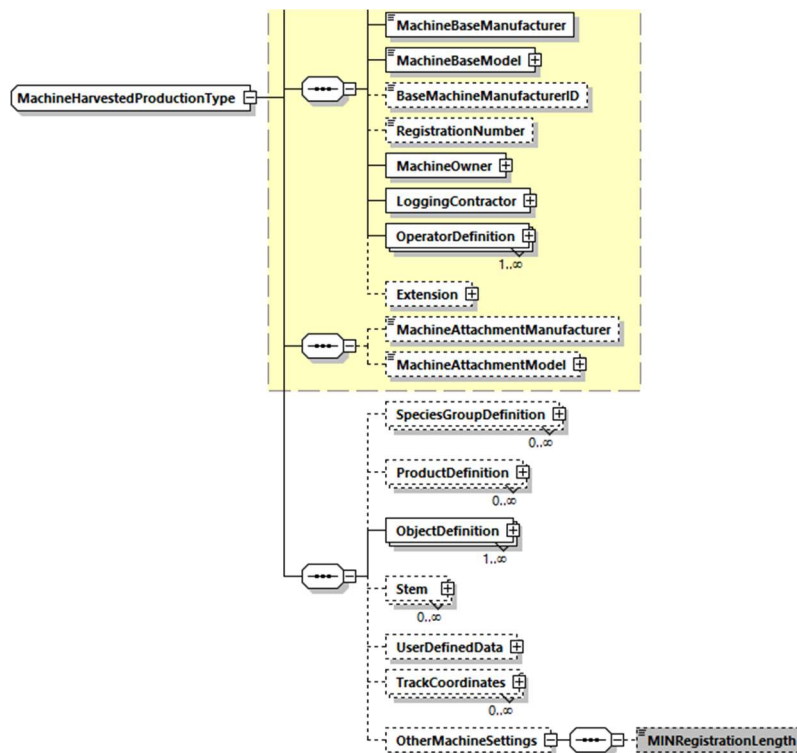
Observe that there is only one manufacturer (X2) where a log longer than 10 cm might be totally discarded without also making an adjustment of the diameter vector.

Possible standard updates to be discussed

Suggested to add optional element LogStartPosition in order to report the position of the butt-end of the log. The position is defined as the distance from the first (0) value in the diameter vector. The element makes it possible to identify a stem where butt-offs have been discarded without any adjustments to the diameter vector.



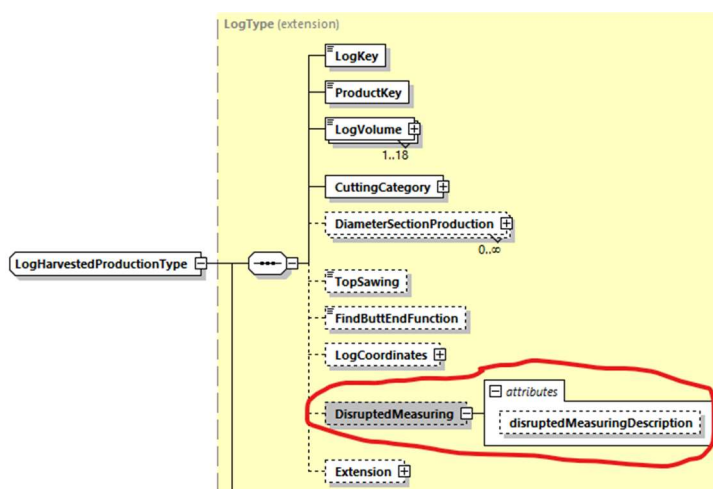
Suggested to add optional element MINRegistrationLength in order to make it possible to check which minimum length is in use. It will be used in order to keep track of what setting is in use. This element will not make it possible to tell whether a very short log has been cut without being registered or not.



Comments from secretary

As there is only one control system (X2 in table above) where this issue may have a serious impact on the control measurement it is not deemed to be a very urgent issue for a majority of the control systems.

It is suggested that we discuss the possibility of adding MINRegistrationLength and LogStartPosition in the hpr-schema at the upcoming meeting. We may also discuss to use the new element “DisruptedMeasuring” (decided 2023-04-26) whenever a butt-off has been discarded from the stem.



NEW POINTS/FEATURES OF INTEREST

Briefly discussed at the meeting due to limited available time.

It was decided at the last meeting to let the secretary study how to handle “point/feature of interest” rather than extending the use of StemCodes, perhaps using ogr.

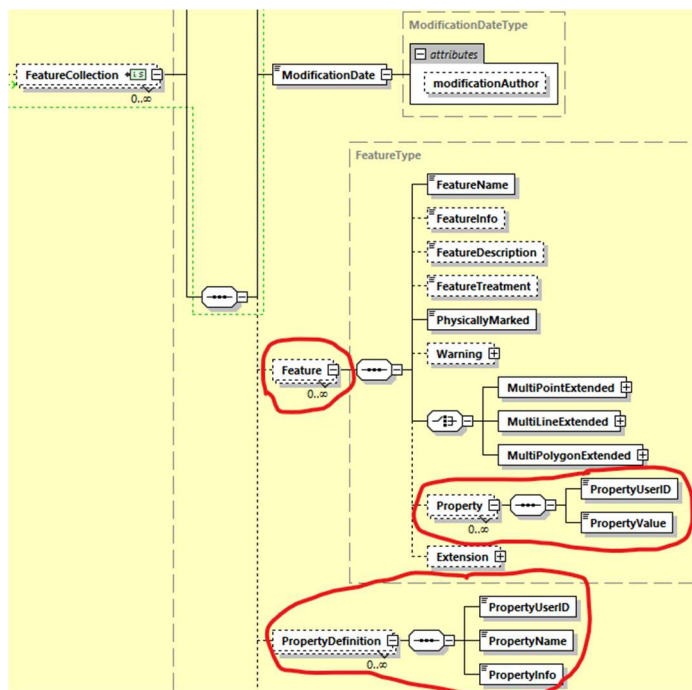
A concrete example may be if the machine operator finds an old “boundary stone” (see photo below) marking the border between two different properties. This type of stone is still legally binding if there is a conflict between different property owners as the boundaries on a map may not be 100% correct. It is thus very important to get correct positions on this type of boundary stones.



We could of course add a new stem code for “boundary stones” but these are always referencing a harvested stem that is probably located a number of meters away from the stone.

Another problem with stem codes is that the hpr-file is usual “partially” reported including only “new” stems. If we want the operator to add POI there will probably be situations where the operator deletes or modifies previous reported POI.

With some modifications to ogr and ogr we could have a situation where it is simple to add any features using either a GIS interface or some type of short-cut button. An advantage with ogr is that it could be viewed as an accumulative report for the object whereby all features for the object are always reported. However, this probably needs a couple of updates to the ogr/ogr schemas as partly described at last meeting and illustrated below where two new structures are suggested.



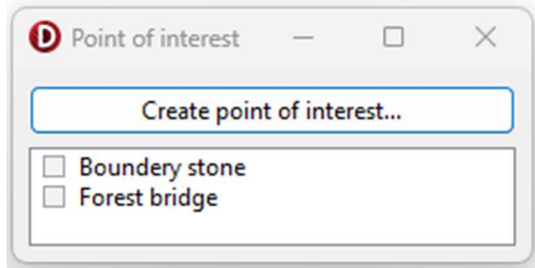
Name	Data type	Unit	Description
Property			Structure for register properties per feature
PropertyUserID	String	Free text	Identity per property defined by user of data, normally by logging organisation. Do not use a single space or null value. Do not begin or end with a space. Do not include any of the following characters: Double space, Linefeed, carriage return, %, ?, lt, gt, :, " (double quote), /, \, , *.
PropertyValue	String	Free text	Property value. Observe that the name and possible ID is found in PropertyDefinition which is referenced using PropertyUserID.

Name	Data type	Unit	Description
FeaturePropertyDefinition			Structure for register property definitions per feature collection
PropertyUserID	String	Free text	Identity per property defined by user of data, normally by logging organisation. Do not use a single space or null value. Do not begin or end with a space. Do not include any of the following characters: Double space, Linefeed, carriage return, %, ?, lt, gt, :, " (double quote), /, \, , *.
PropertyName	String	Free text	Name of property
PropertyInfo	string	Free text	Free text identity information per property. Identity element normally to be used by logging organization. No constraints in standard concerning how to use this element.

Ogi-example illustrating empty FeatureCollection with a list of available properties:

FeatureCollection	Feature	PropertyDefinition
HarvestingFeedback	Null/Empty	"Boundary stone"; Code_68 "Forest bridge"; Code_23

Possible operator GUI for selecting a property where a point may have more than one properties:



Ogr-example illustrating a FeatureCollection with two points added by operator with a selected property:

FeatureCollection	Feature	Feature.Property	PropertyDefinition
HarvestingFeedback	Name: "Boundary stone"; GeoJson: Point X/Y/Z	UserID = Code_68 Value = 1	"Boundary stone"; Code_68
	Name: "Forest bridge"; GeoJson: Point X/Y/Z	UserID = Code_23 Value = 1	"Forest bridge"; Code_23

No objections regarding this proposal were raised at the meeting.

STEMCODES

The issue of making it possible to control which StemCodes to be used through the oin-schema was not discussed due to time running out. However, the secretary is hesitant to add this layer of complexity if there is no urgent need and if the previous ideas regarding POI is deemed acceptable.

CALIBRATION OF MULTITREEPROCESSING

This issue was discussed on the 22nd of November.

Martin Whillans presented results from the project to develop a method controlling and calibrating multi-tree handled stems as illustrated below.

Calibration of multi tree processing (MTP)



Method:

1. Multi tree handling – the first stem in every bunch is colour-marked
2. Every 20th MTP-bunch is selected by control system for control measurement. Stems released and register as MTF-stem in hpr.
3. Operator confirms real number of stems in bunch
4. Single tree processing of every stem in bunch. Coloured stem processed first.
5. STP-stems register in both hpr and hqc.

The tested procedure can be described as follows:

1. Operator accumulates several stems to be processed (MTP). First stem always color marked.
2. Bunch is randomly selected as a control bunch.
3. Bunch registered as MTF bunch in hpr.
4. The operator releases stem bunch on ground.
5. The operator processes the individual stems starting with the first stem (color marked) in the bunch.
6. The stems are also stored in an hqc in order to make it possible to identify the control stems.
7. Analysis and calibration based on comparison of MTF and STP stems registered in hpr.

A consequence of this project might be a proposal to add a new optional element ControlStemCategory to the hpr schema with one of the following enumeration values as this would make it possible to easily identify hpr stems selected for control:

- *Random HQC*
- *Operator HQC*
- *Random MultiTreeCalibration*
- *Operator MultiTreeCalibration*

The same stems are stored in the hpr both as MTF and STP in the test machines. This means a double registration where no felled stems will be found at the object since they are always processed. It is therefore suggested that a new structure for storing control data from the multi-tree-felling is added where it is also possible for the operator to manually input how many that were actually felled (element NoOfStemsInBunchManual). It is also suggested that an element NoOfStemsInBunchMachine is added in order to register the number of felled stems in the bunch as estimated by the harvester.



Below is an example of data stored according to the suggested update where all stems are registered as SingleTreeProcessed stems:

StemKey	SpesGrp-Name	DBH	Ref-Diam	HarvestDate	m3	ControlStem-Category	DBH*	Spes*	Rel-Dia*	m3*	Bunch-stms* (operator)	Bunch-stms* (machine)
3804	BJÖRK	113	113	17/10 T13:38:27	0,053							
3806	GRAN	77	75	17/10 T13:39:08	0,017	Random MultiTreeCalibration	81	Gran	82	0.021	2	2
3807	GRAN	115	113	17/10 T13:39:30	0,059	Random MultiTreeCalibration	81	Gran	82	0.021	2	2
3808	TALL	168	164	17/10 T13:40:07	0,157							
3809	TALL	186	183	17/10 T13:40:37	0,155							

*Data from MTF registered under the new element MultiTreeControlData

It was decided to discuss this proposal at upcoming meetings.

NEW BARK FUNCTION IN 4.0

The secretary briefly presented how to convert bark functions from version 3 to version 4 as illustrated below.

STEP 1) Setting new category according to 4.0

```

If v113t7 = 1 or barkFunctionCategory = 'Swedish Zacco' then
    BarkFunctionUserID := 'Swedish Zacco' (v 4.0)
    BarkFunctionCategory := 'Consolidated' (v 4.0)
else v113t7 = 2 or barkFunctionCategory = 'German' then
    BarkFunctionUserID := 'German' (v 4.0)
    BarkFunctionCategory := 'MatrixDiameter' (v 4.0)
else v113t7 = 3 or barkFunctionCategory = 'Skogforsk 2004, Scots pine' then
    BarkFunctionUserID := 'Skogforsk 2004, Scots pine' (v 4.0)
    BarkFunctionCategory := 'NonLinearLatitude' (v 4.0)
else v113t7 = 4 or barkFunctionCategory = 'Skogforsk 2004, Norway spruce' then
    BarkFunctionUserID := 'Skogforsk 2004, Norway spruce' (v 4.0)
    BarkFunctionCategory := 'Consolidated' (v 4.0)
else v113t7 = 4 or barkFunctionCategory = 'GermanDistanceBased' then
    BarkFunctionUserID := 'GermanDistanceBased' (v 4.0)
  
```

```

        BarkFunctionCategory := 'MatrixDistanceDBH' (v 4.0)
    else barkFunctionCategory = 'LogisticTypeBarkModel' then
        BarkFunctionUserID := 'LogisticTypeBarkModel' (v 4.0)
        BarkFunctionCategory := 'Logistic' (v 4.0)

```

STEP 2) Setting new parameters according to 4.0

```

Reset all parameters a0-d1 to 0 (zero) in consolidated function.
if BarkFunctionUserID = 'Swedish Zacco' then
    ConsolidatedFunction.a0 := ConstantA or var113t1
    ConsolidatedFunction.b0 := FactorB or var113t1
else if BarkFunctionUserID = 'German' then
    MatrixDiameter.BarkDeduction[nn] := BarkDeduction[nn] or var113t3;
    MatrixDiameter.BarkDeduction[nn].LowerDiameterLimit := LowerDiameterLimit or var113t2;
else if BarkFunctionUserID = 'Skogforsk 2004, Scots pine' then
    NonLinearLatitude.Latitude := Skogforsk2004ScotsPine .Latitude or var113t4
else if BarkFunctionUserID = 'Skogforsk 2004, Norway spruce' then
    ConsolidatedFunction.a0 := 0.46146;
    ConsolidatedFunction.b0 := 0.03571;
    ConsolidatedFunction.c0 := 0.01386;
else if BarkFunctionUserID = 'GermanDistanceBased' then
    MatrixDistanceDBH.* := 'GermanDistanceBased.*';
else if BarkFunctionUserID = 'LogisticTypeBarkModel' then
    LogisticDistanceDiameter.* := LogisticTypeBarkModel.*;

```

During the discussion it became clear that the main issue for Jonas Thorsson is when a harvester is receiving 4.0 instructions, but the production result is reported in an hpr according to version 3.0. It is in several cases not possible to convert from the new 4.0 bark function to the older versions.

It is suggested with the minutes to recommend that the enumeration value “None” is registered in attribute “barkFunctionCategory” in these cases when converting bark parameters from version 4 to version 2 and 3.

NEW TOOL: “STANFORD_HPRVERIFIER”

Postponed to upcoming meeting due to the fact that the secretary has not had time to do any significant work on this issue.

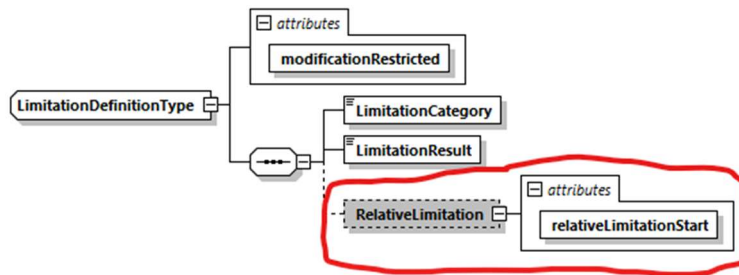
RELATIVELIMITATIONMATRIX

Jyrki Vainio, Trimble, presented the results from simulator tests carried out together with Ponsse as described in appendix 3. This issue has been discussed at a couple of meetings during 2020 to 2022.

The basic idea as described in a number of previous meetings is to introduce a new type of limitation matrix where the limit is relative rather than absolute. The idea is also to include an attribute “relativeLimitationStart” that indicates when this type of limitation will affect the bucking

The proposal is to add the following new element and attribute to the LimitationDefinition:

```
<RelativeLimitation RelativeLimitationStart="5">true</RelativeLimitation>
```



Name	Data type	Unit	Description
RelativeLimitation	Boolean		LimitationCategory and PriceMatrix.Limitation interpreted as a relative values if value is TRUE. All other cases interpreted as an absolute limitation.
relativeLimitationStart	nonnegative-Integer	Pcs/m3	Minimum total number/volume of harvested log per product before the relative limitation matrix is applied. Relative limitation not in use when total volume is below this value. Logs harvested before this limit is reached is taken in account in the limitation calculation.

The meeting discussed the results and the objectives. Johan J Möller pointed out that this new functionality may be of interest to other markets but that it will generally decrease the value given that the operator behavior is correct regarding when a log is cut manually.

The next step is running a practical test in a Ponsse harvester before deciding on a standard update.

The secretary has done a test of the relative limitation matrix using Skogforsk bucking simulator Aptan after the meeting. This implementation seems to work as expected with a slight decrease in value and saw log volume when the number of short saw logs is limited to e.g. 5%.

REGISTERING STEMS WITH MULTIPLE FORKS IN HPR

This issue was prepared by Tapio Räsänen. As time was running out this issue was not discussed in any detail at the meeting.

A question has been raised in Finland how stems with two or more “sub-stems” (stems with one or several forks) should be measured and saved in the hpr so that these stems could be managed in a consistent way



An argument for the improvement is that count of harvested trees can be calculated incorrectly for objects including a lot of stems with forks depending on the harvester's registration method and operator's working style

Currently a stem with a fork may be registered in different ways depending on controller and how the operator processes the stems:

- Logs of sub-stems included in the main stem
- Sub-stems and their logs as separate single stems

Development of automatic calculation of thinning results and harvesting quality monitoring systems based on hpr-data require that the count of harvested stems is correct. This is especially important in first thinnings.

This also influences the calculation of average tree size (volume or DBH) and therefore on the price of harvesting. This means that a correct stem count is also a cost-calculation and harvesting work compensation matter.

The objective with the proposal is that if a sub-stem is saved as a separate stem, it should have a reference to the main stem. However, it is a practical challenge that stems with sub-stems can be processed in so many ways.

How these stems are registered also affects the post-processing of the diameter vector.

Example all forks registered as one single stem

Stem count, basal area and mean volume of removed trees are correct when used for

- follow-up of thinnings
- calculating the remaining stock
- updating forest resource data based on operations
- using harvester data as ground truth for remote sensing

Processing time per stem gets higher which has an effect on productivity key figures and pricing of logging.



Example forked stem registered as separate stems

Stem count, basal area and mean volume of removed trees may be misleading when used for

- follow-up of thinnings
- calculating the remaining stock
- updating forest resource data based on operations
- using harvester data for ground truth of remote sensing

Processing time per stem corresponds better to actual logging conditions when used for productivity key figures and pricing of logging.



Possible solutions

A possible proposal is that in case when a fork of the stem is registered as a separate stem it would either have a reference to the main stem e.g. a new optional element `MainStemNumber` or at least be marked as a fork with a new Boolean type element (e.g. `ForkProcessing`).

In cases when forks are registered to the main stem the stem could be marked with a new Boolean type element (e.g. `ForkProcessing`).

Comment from secretary:

Maybe a solution could be to add a new boolean element `StemFellCut` indicating if a “fell cut” was used (e.g. triggered by a combination of “tilt down” and “saw bar out”). This would also make it possible to identify the top part of a broken stem.

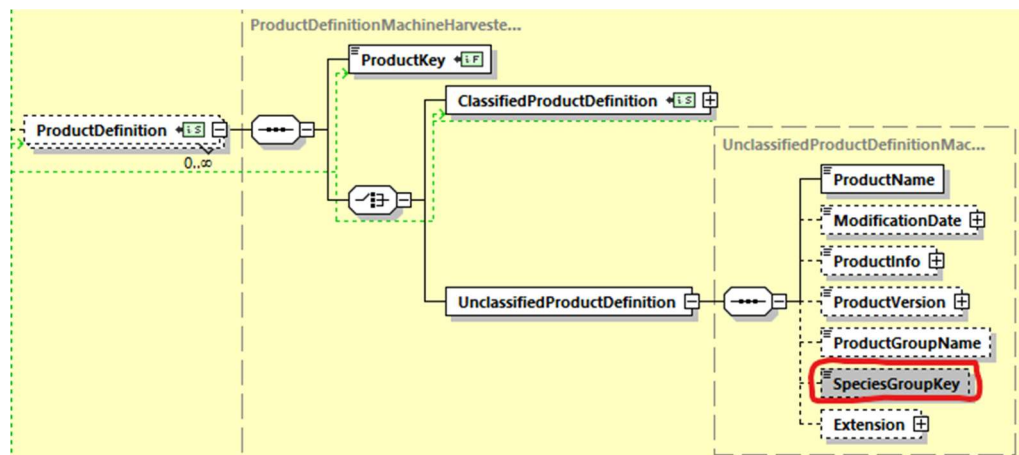
An idea mentioned by Tapio was to modify `ProcessingCategory` with a new enumeration value “`ForkProcessing`”. However, the secretary is quite hesitant since the `ProcessingCategory` is presently used for a separate type of information.

TREE SPECIES OF UNCLASSIFIED PRODUCTS

Issue presented by Tapio Räsänen and Jyrki Vainio.

StoraEnso and Trimble have noted that it is complex to analyse the volume of unclassified logs per species due to the fact that several manufacturers do not register one `UnclassifiedProduct` per `SpeciesGroup` but rather just one `UnclassifiedProduct` for all species.

The standard allows for registering the SpeciesGroupKey for each UnclassifiedProduct as illustrated below. This element was added with version 3.2.



The reason for originally not including this element was that it was deemed enough with the SpeciesGroupKey for each stem. Adding it to the UnclassifiedProduct means that new UnclassifiedProducts need to be created if a SpeciesGroupDefinition is modified.

It is suggested with the minutes that we recommend the use of one Unclassified product per species and that it would be an advantage to use the existing SpeciesGroupKey in the UnclassifiedProductDefinition.

FUEL CONSUMPTION REPORTING IN HPR AND FPR

Presented by Tapio Räsänen.

Fuel costs in logging business have increased in recent years. As energy efficiency reporting evolves, routines are needed to monitor fuel consumption and emission developments transparently, uniformly, representatively and at a sufficiently individual level (support for emission-efficient choices).

There are initiatives from EU whereby relevant reporting of CO2 emissions will become mandatory.

It is therefore proposed to add fuel consumption in StanForD production files (at least hpr and fpr) as optional information. The reporting of fuel consumption should be activated by a machine setting and the fuel consumption should be reported per harvesting object.

Fuel consumption value should be registered as it is received from Engine Control Unit with the unit in litres. Considering CO2 emission reporting an additional unit could be also CO2 in kilograms.

It is also suggested that to discuss if there is a need to report fuel type including product name of fuel and/or share of renewable fuel. The share of renewable fuels has to be taken into account in emission reporting.

A wish is that machine manufacturers would add fuel consumption in Extension part of files for testing and forest company reporting system development purposes. The aim is to move on in the development sooner than waiting for the

support to StanForD versions 4.0 or 4.1. It would probably be good to look at a more advanced and permanent solution for the future based on a separate fuel and emission reporting StanForD 2010 file.

There was a long discussion regarding whether it is suitable to include this information in the normal production files as this is often viewed as sensitive information from a contractor perspective. The alternative solution of reporting a new separate message and/or reporting a calculated CO₂ mass was discussed. Another important issue is how to register the type of fuel and the share of renewable fuel. The main question is who actually has knowledge about this and how to format the fuel type. Fuel type may change depending on the season and the price. On top of this the fuel tank may include a mix from different fuel deliveries.

The meeting decided to let Metsäteho arrange a meeting with Skogforsk in order to discuss this further on the 14th of December 2023.

§8 StanForD2010 projects / implementations

“WOOD VALUE TEST” BASED ON VERSION 4.0

Johan J Möller presented the plans for carrying out a test new harvester test since it is now 6 years since it was last done.

The conclusion from the discussion with the manufacturers at the meeting was that the next test will be carried out in the spring of 2025. The main focus will be on version 4 but will not be a requirement in order to participate.

§10 Other issues

These issues were not discussed due to time running out.

EU DEFORESTATION REGULATION (NOT PRESENTED)

Based on discussion at papiNet meeting 2023-09-20.

The following text probably means that we must be able to describe all harvested areas larger than 4 ha with a polygon.

- (d) *geolocation coordinates, latitude and longitude for all plots of land where the relevant commodities and products were produced, or the geolocation coordinates, latitude and longitude of all points of a polygon for the plots of land where the relevant commodities and products were produced; any deforestation or degradation in the given plots of land, either identified by a single point of latitude and longitude or by polygon, shall automatically disqualify all products and commodities from those plots of land from being placed and made available on the market or exported therefrom; operators shall provide the date or time range or harvesting season of production of the commodity or product; the Commission is empowered to adopt delegated acts in order to supplement this Regulation with regard to the size of the plots of land above which companies are required to provide polygons as the only means of geolocation for the relevant commodities and products;*

The consequence will be that stem coordinates will be viewed as mandatory information on many markets. This means that production may have to be stopped in cases where the GNSS receiver is not working properly.

WINDSTORM “HANS”, HANDLING WINDTHROWS (NOT PRESENTED)

A large storm hit an area in northern Sweden in August 2023. The secretary was contacted by some forest companies in order to find a solution for registering wind throws as this is information required by several insurance companies.

The obvious possible solutions are to use stem codes or new species groups. The conclusion was to use new species groups considering the following factors:

- Limited area with few mills/products
- Limited experience with stem codes
- User interface improvements
- Simple administration with stem codes

Hopefully we will see more operator experience working with stem codes as well as GUIs adjusted for handling large scale calamities in order to have a situation where stem codes can be used in this type of situation in the near future as it would be a much simpler way of registering windthrows.

NEW AGREEMENT FOR STANFORD MEMBERSHIP

This item was not presented in any detail due to running out of time.

The annual membership fee for StanForD has been the same since the year of 2000. Due to the increased work load and costs it is suggested that the fee is increased to 50 000 SEK per year. This applies to 2024 with the invoice sent out at the end of next year. This does not affect the invoice recently distributed. We will discuss this further at the upcoming meetings.

§9 Next meetings

StanForD web meeting 2024-02-07, Teams (09:00-11:30, 13:00-15:00 CET)

StanForD meeting 2024-04-17--18, Helsinki/Teams (12:00-14:00 EET)

By default, all financially contributing members will receive an Outlook invitation to all meetings in advance.

§10 End of meeting

The chairman Johan J Möller thanked everyone for attending the meeting.



Arlinger John

2023-12-21

Standardization of forest regeneration data

A DRAFT STANFORD PROPOSAL

Introduction/Background

The StanForD standard was originally developed for communication of harvester data in the mid 1980's. It was thereafter extended to also make it possible to report forwarder production around 2005. Additional standard extensions were made with the introduction of feller-bunchers (version 3.5, 2019), skidders (version 3.6, 2021) and yarders (version 3.6, 2021). The addition of tree-length machinery means that the standard is basically useable also on markets where a mix of cut-to-length (CTL) and tree-length is in use. This is a clear consequence of the fact that the StanForD standard has moved from being a "Finnish-Swedish affair" to being a global communication standard.

Several actors using StanForD has pointed out that they see a need also for being able to retrieve production data from machines carrying out silvicultural work such as site preparing and planting machines. This need was first communicated with the standard secretary by StoreEnso (Johan Haglöf, Sweden) and PHDForest (Ian Wilson, NZ) in 2020. This issue has also been discussed more recently with Urban Nordmark (Sveaskog) and Dermot Cunniffe (Coillte). The work on this proposal was not begun on any significant level until the late autumn of 2022 due to the heavy work load caused by upgrading the standard to a new major version 4.0 which was not finalized until August 2022. The proposal has also been discussed with a number of manufacturers of forest regeneration machinery such as Bracke, Risutech and PlantmaX which has resulted in significant improvements to the proposal. M-Planter has been approached but no meeting has been held.

An important factor is the efforts of a large number of actors to develop mechanized planting machines. It is almost inconceivable to assume these machines would be widely used without having a way of reporting the work results in a digital format.

The objective of this document is to describe how a standard for reporting site preparation and planting results.

Present standard structures

MACHINEDEFINITION

All standard messages for reporting StanForD-data from a machine includes a structure for reporting machine identities, brand, model and relevant contact information as illustrated in figure 1 and 2. This structure is generic which means that it can also be used by new machine types such as site preparing and planting machines.

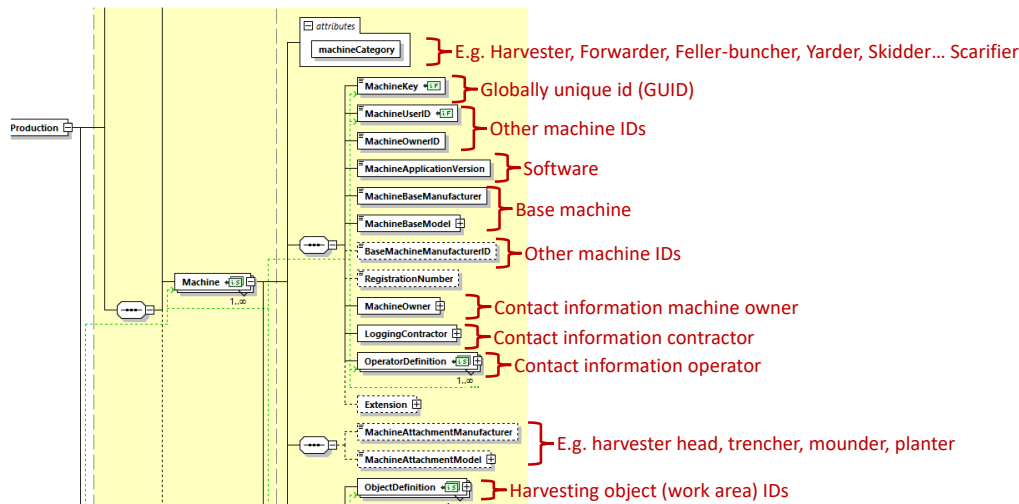


Figure 1. Illustration of generic MachineDefinition structure presently used in all StanForD schemas.

= machineCategory	Harvester	E.g. Harvester, Forwarder, Scarifier
<> MachineKey	636128963318900000	Globally unique id (GUID)
<> MachineUserID	9313021211	
<> MachineOwnerID		
<> MachineApplicationVersion	MaxiXplorer 3.10.X.28740 D	Software
<> MachineBaseManufacturer	Komatsu Forest	Base machine
<> MachineBaseModel	931	
MachineOwner		
LoggingContractor		
OperatorDefinition		
MachineHeadManufacturer	Komatsu Forest	Attachment
MachineHeadModel	C144	
ObjectDefinition		
ObjectUserID agency="Other" 132676_5		Traktnr/namn
ObjectName	Brännmossen FA 1a	
ObjectModificationDate	2016-10-25T10:47:18.137+02:00	
ForestCertification (2)		
LoggingForm <LoggingFormCode> AAZ		
ForestOwner		
ContractNumber		
ContractCategr	VV	VO
RealEstateIDObject	999888	
ObjectKey	5	
StartDate	2016-10-25T10:44:32.653+02:00	Start av avverkning

Figure 2. Example data stored in MachineDefinition from a Komatsu harvester.

TRACKING

The possibility to include tracking data was added to all messages sent from a forest machine in 2017 (version 3.3) as illustrated in figure 3 and 4. This is also a generic structure used for all possible machine types and message types reported from a machine except quality control messages.

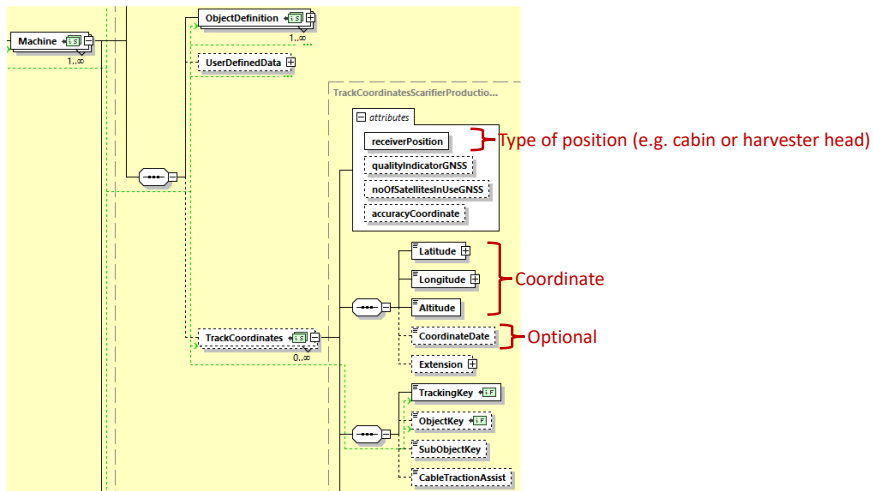


Figure 3. Schema structure for TrackCoordinates



Figure 4. Tracking data (green lines) extracted from harvester hpr-file. Yellow dots represents harvested stems.



Figure 5. Tracking data extracted from forwarder fpr-file. Different colors primarily dependent on speed of forwarder.

The StanForD schemas are designed in order to make it possible to extend the tracking for different machine types as illustrated in figure 6. This means that it is possible to extend this structure specifically for site preparing and planting machines.

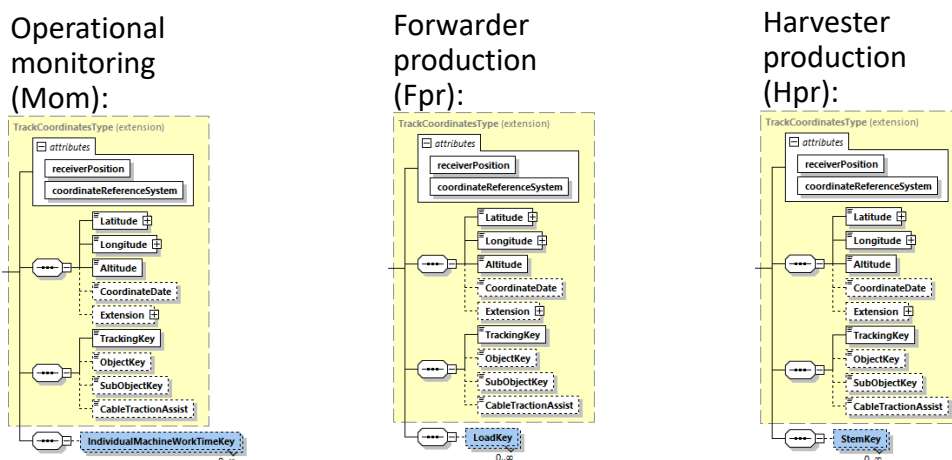


Figure 6. Illustration of the differences in how tracking can be used in different message (mom/hpr/fpr).

Draft proposal

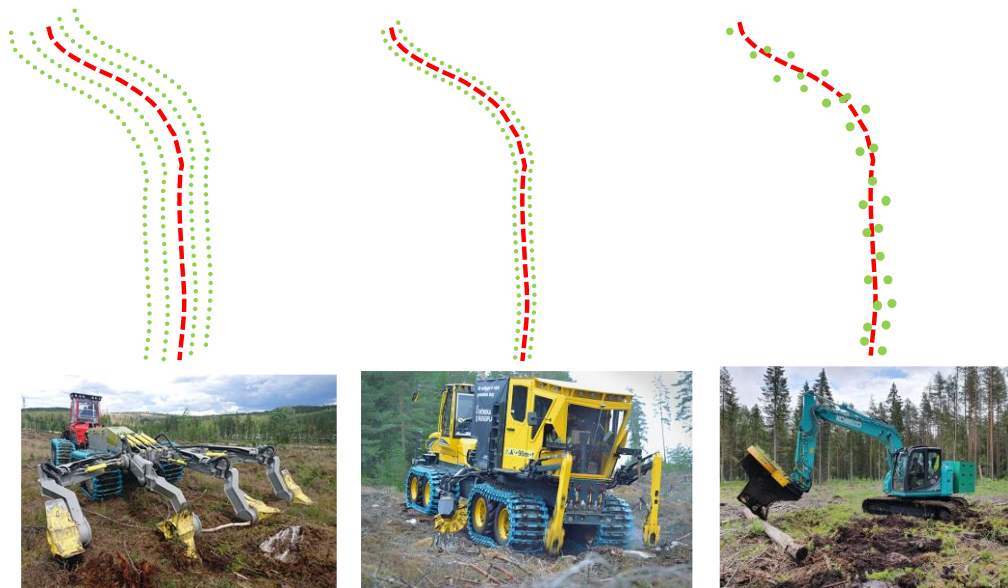
This section outlines a proposal for a new schema (ForestRegenerationProduction_V*p*.xsd) that includes the possibility to report site preparation and planting work. The file extension for the new messages is to be “rpr” (abbreviation for regenerated forest production).

DESIGN

The basic idea is to re-use the MachineDefinition and TrackCoordinate structures for site preparing and planting machines as tracking data is most probably a useful structure for “carrying” information regarding the work of a site preparing and/or planting machines. The basic idea is to make it possible to extract information about where and when the machine has been working (line describing the position of machine during work and transportation) as well as the total width of the treatment (e.g. width of zone that has been prepared/scarified). The original idea was to create separate schemas for site preparing and planting machines. However, as several different machine constructions can simultaneously carry out site preparation and planting/sowing it is suggested that one single schema is constructed. The fundamental idea is hence to register the movement of the machine as well as points or lines describing where work has been carried out as illustrated in figure 7-12.

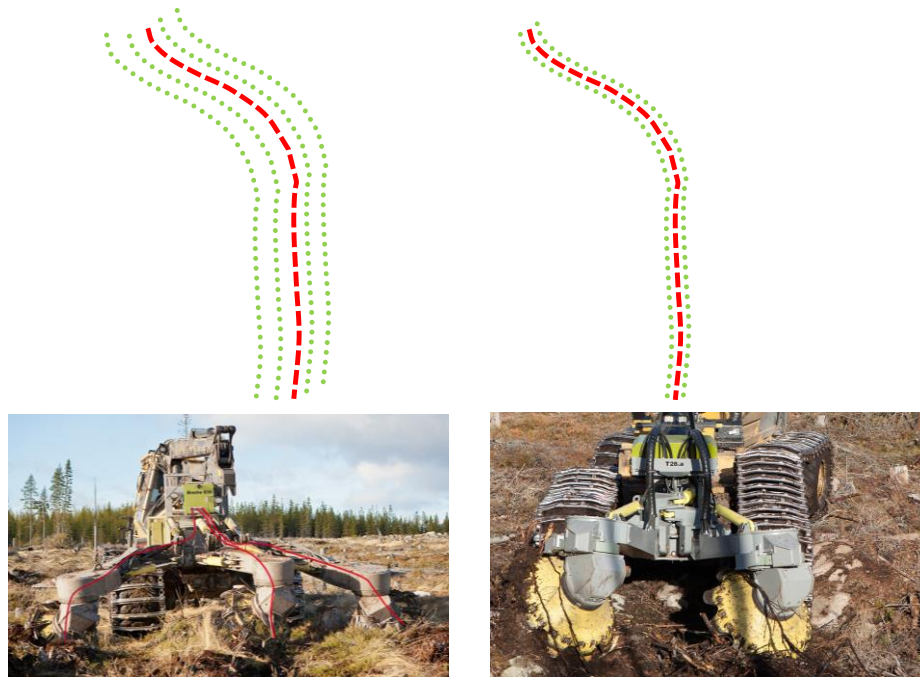
The work process can be considered to be *continuous* or *intermittent* both in the case of site preparation and planting/sowing machines. Typically planting of seedlings is an intermittent work where points with a single seedling are produced. On the other hand, a sowing machine is often sowing a row where the individual seed is not tracked, this could be viewed as continuous work along a line. Different types of site preparing machines could also carry out both continuous

and intermittent work. Typically a moulder will generate points that can be planted or sowed while a trencher will generate continuous lines that are suitable for planting or sowing.



Intermittent treatment (points)

Figure 7. Basic data registered for both site preparation and planting. The red line represents the movement of the machine (tracking) while the green points represent the positions (points) that have been prepared and/or planted.



Continues treatment (lines)

Figure 8. Basic data registered for both site preparation and planting. The read line represents the movement of the machine (tracking) while the green lines represent the rows that have been prepared and/or planted. Observe that the left hand machine is simultaneously site preparation and sowing.



Continues treatment (line where machine is enough)

Figure 9. Basic data registered for site preparation. The read line represents the movement of the machine. Since the treated line is identical with the machine tracking it is not deemed necessary to include any additional positions describing the treated lines (green lines in previous examples).

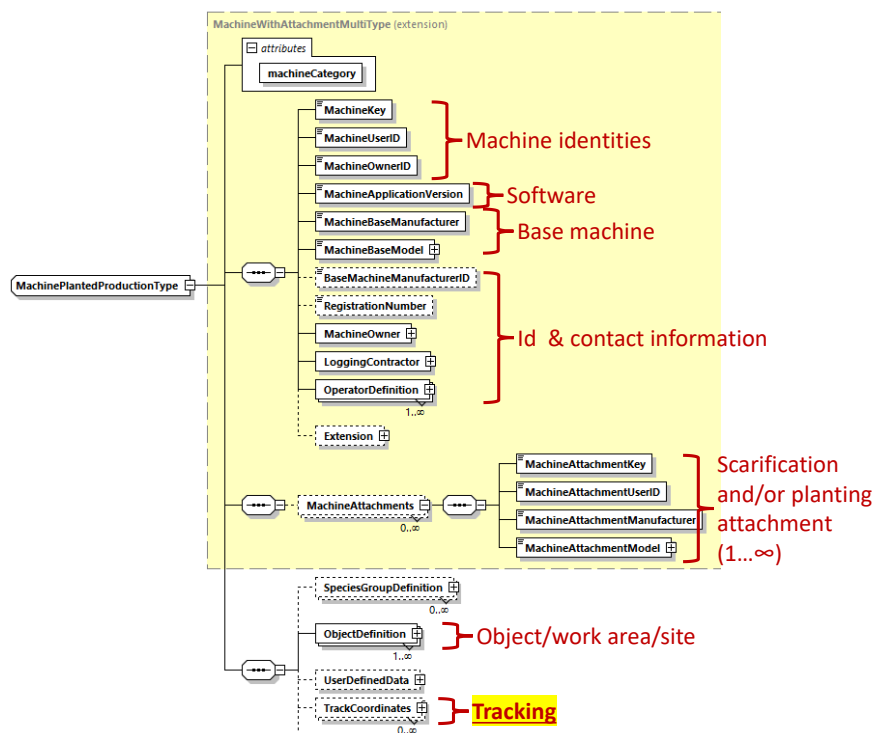


Figure 10. Basic structure for machine data where element MachineAttachment is repeatable since both site preparing and planting machines may have several separate devices (e.g. a four row disc trencher) several separate MachineAttachments could be registered.

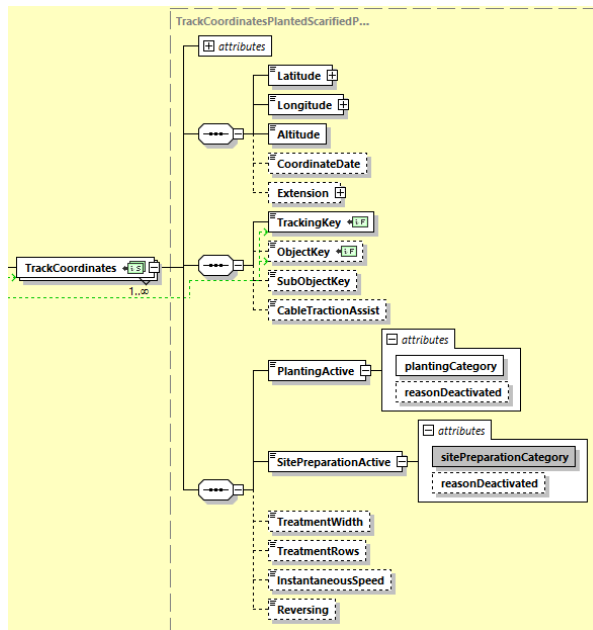


Figure 11. Tracking structure including both planting and site preparation data. Observe that planting/sitePreparationCategory are both enumeration lists with values *Continuous* or *Intermittent*.

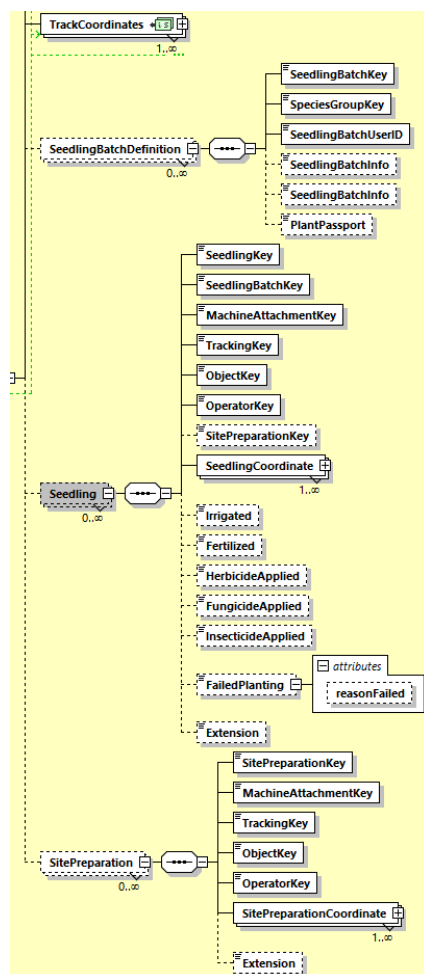


Figure 12. Detailed information describing the work of each individual attachment. This structure makes it possible to e.g. report data from a site preparing machine that is sowing only certain parts of an object (work area) while preparing the ground of the whole object. Both Seedling and SitePreparation structures can be interpreted as a "line"

or a "point" depending on type of equipment in use (see attributes `plantingCategory` and `sitePreparationCategory`). Both `SitePreparationCoordinates` and `SeedlingCoordinates` are repeatable in order to make it possible to register position of base machine and attachment.

WIDTH OF TREATMENT

There are two elements included under the `TrackCoordinates` where the width of the treatment can be registered. This is probably primarily of interest when carrying out continuous site preparation work. The reason for including this information is to do an estimate of treated area in cases where only the tracking structure is reported. It may also be relevant in case there are regulations limiting the relative area of soil disturbances. The two different elements are illustrated below in figure 12b.

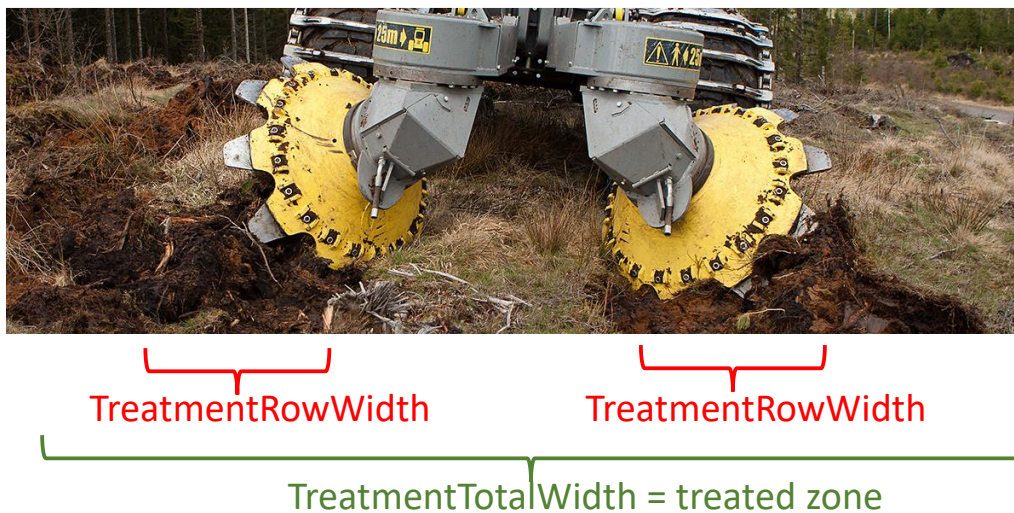


Figure 12b. Illustration of how to use element `TreatmentRowWidth` vs. `TreatmentTotalWidth`.

DETAILED SEEDLING INFORMATION

The `Seedling` structure includes a large number elements and attributes with information describing how the seedling was treated as well as whether it failed (figure 13). It has been discussed to also include information about what type and quantity of pesticide or fertilizers that has been used. However, no concrete use case has been presented and it is therefore postponed. Observe that `Extension` elements are available for both `Seedling` and `SitePreparation` structures.

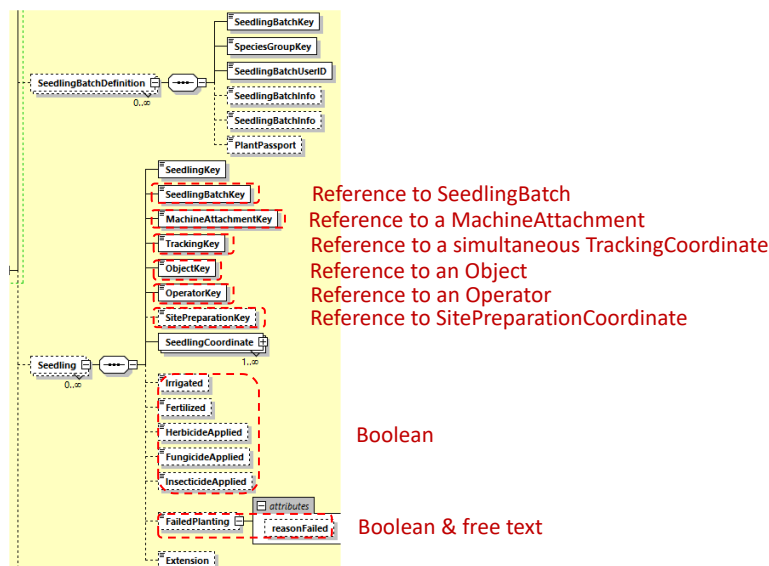


Figure 13. Structure for registering data per seedling.

A complex issue is how to include relevant identity information as a fairly large number of different identities are in use by different actors when producing and distributing seedlings. There is also an EU regulation that requires a so called “Plant passport” (figure 14). Three identity elements were therefore added to the SeedlingBatchDefinition structure (PlantPassport, SeedlingBatchInfo and SeedlingBatchVersion). This structure is unbounded which means that it is flexible enough so that one batch could represent anything from an individual seedling to a large number of seedling delivered in one container. However, the most common would probably to use it for a cardboard box with seedlings as delivered from the nursery.

The content of the plant passport	
Point in the plant passport	Contents
A	The plant's or plant product's botanical name (species or family), e.g. <i>Sorbus aria</i> or <i>Pelargonium</i> .
B	The country code and the plant passport issuer's registration number at the Swedish Board of Agriculture, e.g. SE-XXXXXX.
C	The traceability code (for example, lot or order number). There is more information about the traceability code below the table.
D	The plant's or plant product's country or countries of origin (in or outside the EU) for example, NL, DK, DE, NO or SE.
 Växtpass / Plant Passport	
A XXXXX XXXXXX	B SE-XXXXXX C XXXXX D XX

Figure 14 Description of required information in an EU plant passport

How to trigger coordinate registration

Reporting of planting and site preparing work must always include a machine tracking structure. Including tracking means that we can easily distinguish between areas that have been treated or not.

Each position registered in Seedling or SitePreparation must have a reference to the last specific tracking position. This is the reason why TrackingKey is mandatory in Seedling and SitePreparation

The following events should trigger registration of a tracking position:

1. Distance more than 10 m or lower from last registered tracking position
2. When an intermittent seedling or site preparation position is created
3. When there is a change in treatment/activity. A change in activity occurs when one or several attachments are turned on or off.

INTERMITTENT WORK

Each individually treated point (intermittent work) is registered in element Seedling and/or SitePreparation with a reference to one Tracking position using TrackingKey.

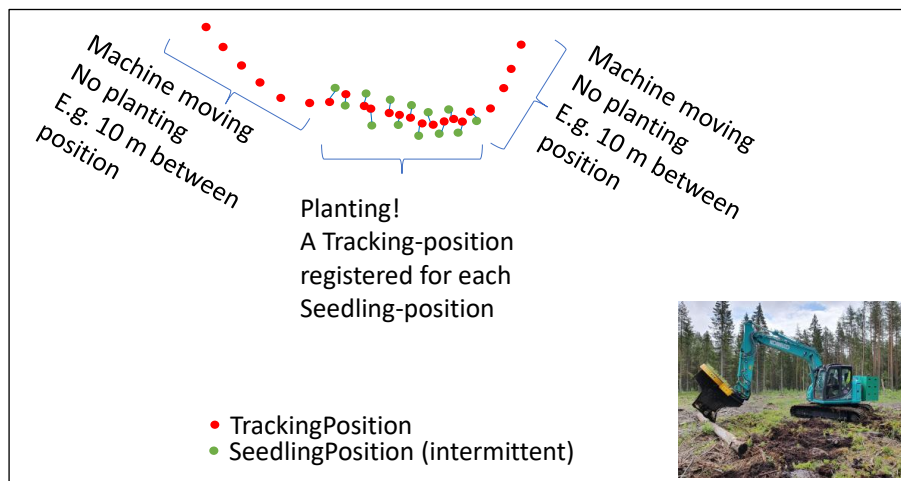


Figure 15. Example illustrating how to register positions during intermittent planting work.

CONTINUOUS WORK

A point describing a row is to be registered with a maximum distance of 10 m in Seedling and/or SitePreparation with a reference to one Tracking position using TrackingKey.

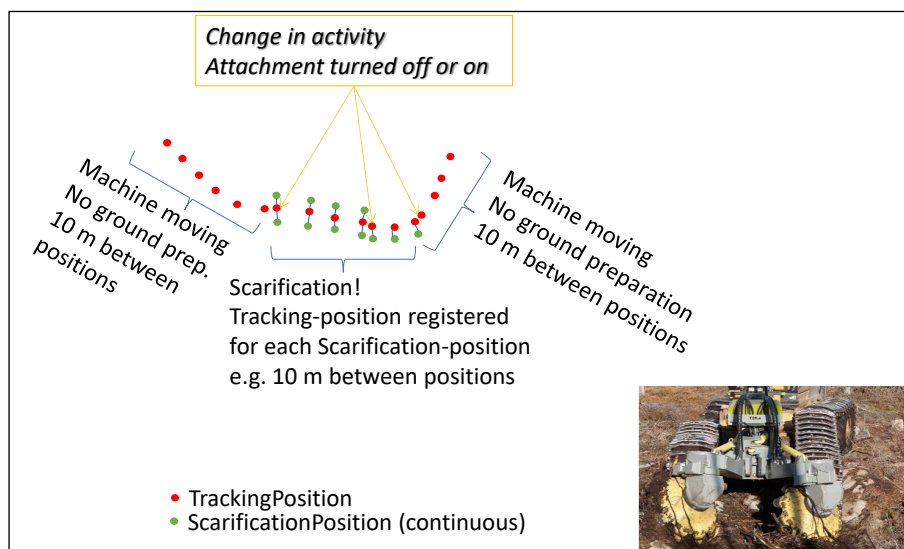


Figure 16. Example illustrating how to register positions during continuous site preparation work.

Examples

TWO-ROW TRENCHER

This is to be considered as a continuous type of work where the coordinates for site preparation per attachment are to be viewed as a line.



Table 1. Tracking example (receiverPosition should be BaseMachine)

Receiver-Position	Tracking-Key	Latitude	Longitude	Date	Planting-Active	SitePrep-Active	Treatment-Width	Treatment-Rows
Base machine	1	60.4429939	17.2760446	2022-09-07 T14:06:07.69	False	False		
Base machine	2	60.4429941	17.2760458	2022-09-07 T14:06:21.32	False	True	250 cm	2
Base machine	3...5				False	True	250 cm	2
Base machine	6	60.4430663	17.2759374	2022-09-07 T14:11:12.14	False	True	125 cm	1
Base machine	7	60.442985	17.2758838	2022-09-07 T14:53:08.25	False	True	250 cm	2
Base machine	8	60.4429898	17.2757086	2022-09-07 T15:02:33.63	False	False	250 cm	2
Base machine	9	60.4429413	17.2755655	2022-09-07 T15:05:38.66	False	False		

Table 2. SitePreparation example

SitePrep.-Key	Tracking-Key	Attachment-Key	Receiver-Position	Latitude	Longitude	Date
1	2	1	Attachment	60.4429941	17.2760458	2022-09-07T14:06:21.32
2	2	2	Attachment	60.4429841	17.2760758	2022-09-07T14:06:21.32
3	3	1	Attachment	60.4430663	17.2759374	2022-09-07T14:06:32.86
4	3	2	Attachment	60.4430763	17.2760374	2022-09-07T14:06:32.86
5	4	1	Attachment	60.442985	17.2758838	2022-09-07T14:06:46.53
6	4	2	Attachment	60.442986	17.2758938	2022-09-07T14:06:46.53
7	5	1	Attachment	60.4429878	17.2757186	2022-09-07T14:07:01.13
8	5	2	Attachment	60.4429908	17.2757086	2022-09-07T14:07:01.13

PLANTING MACHINE ON EXCAVATOR

This is to be considered as an intermittent type of work where the coordinates for seedlings and site preparation per attachment are to be viewed as large number of points.



Table 3. Tracking example (receiverPosition should be BaseMachine)

Receiver-Position	Tracking-Key	Latitude	Longitude	Date	Planting-Active	SitePrep.-Active	Treatment-Width	Treatment-Rows
Base machine	1	60.4429939	17.2760446	2022-09-07T14:06:07.69	False	False		
Base machine	2	60.4429941	17.2760458	2022-09-07T14:06:21.32	True	True		
Base machine	3...5				True	True		
Base machine	6	60.4430663	17.2759374	2022-09-07T14:11:12.14	True	True		
Base machine	7	60.442985	17.2758838	2022-09-07T14:53:08.25	False	False		
Base machine	8	60.4429898	17.2757086	2022-09-07T15:02:33.63	False	False		
Base machine	9	60.4429413	17.2755655	2022-09-07T15:05:38.66	False	False		

Table 4. SitePreparation example

SitePrep.-Key	Tracking-Key	Attachment-Key	Receiver-Position	Latitude	Longitude	Date
1	2	1	Attachment	60.4429941	17.2760458	2022-09-07T14:06:21.32
2	3	1	Attachment	60.4430663	17.2759374	2022-09-07T14:06:32.86
3	4	1	Attachment	60.442985	17.2758838	2022-09-07T14:06:46.53
4	5	1	Attachment	60.4429878	17.2757186	2022-09-07T14:07:01.13

Table 5. Planting example

Seedling-Key	Tracking-Key	Attachment-Key	Species	Receiver-Position	Latitude	Longitude	Date
1	2	1	Pine	Attachment	60.4429941	17.2760458	2022-09-07T14:06:21.32
2	3	1	Pine	Attachment	60.4430663	17.2759374	2022-09-07T14:06:32.86
3	4	1	Pine	Attachment	60.442986	17.2758938	2022-09-07T14:06:46.53
4	5	1	Pine	Attachment	60.4429878	17.2757186	2022-09-07T14:07:01.13

TWO-ROW PLANTER AND TRENCHER

This is to be considered as an intermittent type of work where the coordinates for seedlings and site preparation per attachment are to be viewed as large number of points.



Table 6. Tracking example (receiverPosition should be BaseMachine)

Receiver-Position	Tracking-Key	Latitude	Longitude	Date	Planting-Active	SitePrep.-Active	Treatment-Width	Treatment-Rows
Base machine	1	60.4429939	17.2760446	2022-09-07T14:06:07.69	False	False		
Base machine	2	60.4429941	17.2760458	2022-09-07T14:06:21.32	True	True	250 cm	2
Base machine	3...5	...	...	...	True	True	250 cm	2
Base machine	6	60.4430663	17.2759374	2022-09-07T14:11:12.14	True	True	125 cm	1
Base machine	7	60.442985	17.2758838	2022-09-07T14:53:08.25	True	True	250 cm	2
Base machine	8	60.4429898	17.2757086	2022-09-07T15:02:33.63	False	False		
Base machine	9	60.4429413	17.2755655	2022-09-07T15:05:38.66	False	False		

Table 7. SitePreparation example

SitePrep.-Key	Tracking-Key	Attachment-Key	Receiver-Position	Latitude	Longitude	Date
1	2	1	Attachment	60.4429941	17.2760458	2022-09-07T14:06:22.32
2	2	2	Attachment	60.4429841	17.2760758	2022-09-07T14:06:22.32
3	3	1	Attachment	60.4430663	17.2759374	2022-09-07T14:06:32.86
4	3	2	Attachment	60.4430763	17.2760374	2022-09-07T14:06:32.86
5	4	1	Attachment	60.442985	17.2758838	2022-09-07T14:06:46.53
6	4	2	Attachment	60.442986	17.2758938	2022-09-07T14:06:46.53
7	5	1	Attachment	60.4429878	17.2757186	2022-09-07T14:07:01.13
8	5	2	Attachment	60.4429908	17.2757086	2022-09-07T14:07:01.13

Table 8. Planting example

Seedling-Key	Tracking-Key	Attachment-Key	Species	Receiver-Position	Latitude	Longitude	Date
1	2	1	Pine	Attachment	60.4429941	17.2760458	2022-09-07T14:06:22.32
2	2	2	Pine	Attachment	60.4429841	17.2760758	2022-09-07T14:06:22.32
3	3	1	Pine	Attachment	60.4430663	17.2759374	2022-09-07T14:06:32.86
4	3	2	Pine	Attachment	60.4430763	17.2760374	2022-09-07T14:06:32.86
5	4	1	Pine	Attachment	60.442985	17.2758838	2022-09-07T14:06:46.53
6	4	2	Pine	Attachment	60.442986	17.2758938	2022-09-07T14:06:46.53
7	5	1	Pine	Attachment	60.4429878	17.2757186	2022-09-07T14:07:01.13
8	5	2	Spruce	Attachment	60.4429908	17.2757086	2022-09-07T14:07:01.13

MULCHER

This is to be considered as a continuous type of work where probably only the machine tracking is sufficient to report production as there is only one attachment fastened to the base machine in a fixed position.



Table 9. Tracking example (receiverPosition should be BaseMachine)

Receiver-Position	Tracking-Key	Latitude	Longitude	Date	Planting-Active	SitePrep.-Active	Treatment-Width
Base machine	1	60.4429939	17.2760446	2022-09-07 T14:06:07.69	False	False	
Base machine	2	60.4429941	17.2760458	2022-09-07 T14:06:21.32	False	True	220 cm
Base machine	3	60.4430663	17.2759374	2022-09-07 T14:11:12.14	False	True	220 cm
Base machine	4	60.442985	17.2758838	2022-09-07 T14:53:08.25	False	True	225 cm
Base machine	5	60.4429898	17.2757086	2022-09-07 T15:02:33.63	False	True	220 cm
Base machine	6	60.4429413	17.2755655	2022-09-07 T15:05:38.66	False	False	
Base machine	7	60.442947	17.2753701	2022-09-07 T15:08:19.72	False	False	

Postponed issues

Suggestions/coomments from Skogforsk researchers:

- Add attribute for quantity for fertilization/irrigation/spraying
 - Maybe add attributes quantityVolume and quantityMass

New elements and attributes specifically for ForestRegeneration schema

Name	Data type	Unit	Description
MachineAttachment			Repeatable structure for identity information about attachments. An attachment may be either an equipment for site preparation or for planting.
MachineAttachment-Key	integer	No	Attachment specific identity. Running no recommended, reset only when MachineKey is changed
MachineAttachment-ManufacturerID	String		Attachment identity set by the manufacturer of the machine. This is an identity to be used by manufacturer to identify specific attachment. Not to be modified by operator, machine owner or logging organization.
MachineAttachment-Manufacturer	String		Attachment manufacturer. Free text that describes the attachment manufacturer.
MachineAttachment-Model	String		Attachment model. Free text that describes the model of the harvester attachment.
Attachment-ModelYear	Year		Manufacturing year of attachment.
TrackCoordinates			Structure for tracking coordinates registered with a constant distance (e.g. every 10 m) or time interval (e.g. every 30 seconds)
PlantingActive	Boolean		Planting attachments are planting seedlings
plantingCategory	Enum		Indicates if planting work is to be viewed as intermittent (production result handled as points) or continuous (production result handled as lines). Enumeration values: Intermittent or Continuous
reasonDeactivated	String		Free text describing why an attachment was de-activated.
SitePreparation-Active	Boolean		Site preparation attachments are preparing the site/ground for planting.
sitePreparation-Category	Enum		Indicates if site preparation work is to be viewed as intermittent (production result handled as points) or continuous (production result handled as lines). Enumeration values: Intermittent or Continuous
reasonDeactivated	String		Free text describing why an attachment was de-activated.
TreatmentTotal-Width	NonNegative-integer	cm	Width of the total treated zone that is considered to have been planted or site prepared. This includes all attachments.
TreatmentRow-Width	NonNegative-Integer	cm	The width of a treated "row" created by one attachment.
TreatmentRows	NonNegative-Integer	no	No of rows, typically the same as number of attachments when carrying out continuous work

Name	Data type	Unit	Description
Instantaneous-Speed	NonNegative-Decimal	m/s	The instantaneous speed of the base machine when registering the tracking coordinate.
Reversing	boolean		Indicating if base machine is reversing or not. Always "False" if there is no differens between reversing and or going forward (typically tracked machine).
SeedlingBacth-Definition			Structure for registering identity information about a batch of seedlings. Observe that a batch may describe everything in between a container, a cardboard box or a plastic cartridge. This means that a batch may in theory represent anything in between a single and thousands of seedling.
SeedlingBatchKey			Seedling batch specific identity. Running no recommended, reset only when MachineKey is changed
SpeciesGroupKey			Machine specific identity per species group set by machine. Must be updated if any modifications to species group definition is done. Running number reset only when MachineKey is changed.
SeedlingBatchName			Name per seedling batch.
SeedlingBatchInfo			Free text identity information about seedling batch. Identity element normally to be used to convey identity to logging organization. No constraints in standard concerning how to use this element.
SeedlingBatch-Version			Additional identity information of seedling batch. Identity element normally to be used by logging organization. No constraints in standard concerning how to use this element.
PlantPassport			Additional identity information, e.g. for plant passport data required by EU legislation.
Extension			Extension element can include whatever data the users want. The only requirement is that it is well-formed XML i.e. it is tagged
Seedling			Structure for seedling positions and seedling data. Can be used also for continuous sowing of seeds.
SeedlingKey			Specific identity for each seedling position. Running no recommended, reset only when MachineKey is changed. Seedling specific identity. Running no recommended, reset only when MachineKey is changed
SeedlingBatchKey			Seedling batch specific identity. Running no recommended, reset only when MachineKey is changed
MachineAttachment-Key			Attachment specific identity. Running no recommended, reset only when MachineKey is changed.
TrackingKey			Machine unique tracking coordinate identity, set by machine. Must be totally unique for a certain MachineKey.
ObjectKey			Machine specific identity per object. Set when new object is started. Running no recommended, reset only when MachineKey is changed
OperatorKey			Machine unique operator identity, set by machine
SitePreparationKey			
SeedlingKey			Seedling specific identity. Running no recommended, reset only when MachineKey is changed.
SeedlingCoordinate			Seedling coordinate.

Name	Data type	Unit	Description
Irrigated			Indicating if seedling was irrigated when planting was carried out. Optional element only used if attachment is equipped for irrigation.
Fertilized			Indicating if seedling was fertilized when planting was carried out. Optional element only used if attachment is equipped for fertilization.
HerbicideApplied			Indicating if herbicide was applied to seedling when planting was carried out. Optional element only used if attachment is equipped for spraying.
FungicideApplied			Indicating if fungicide was applied to seedling when planting was carried out. Optional element only used if attachment is equipped for spraying.
InsecticideApplied			Indicating if insecticide was applied to seedling when planting was carried out. Optional element only used if attachment is equipped for spraying.
FailedPlanting			Indicating if planting of a seedling failed, e.g. due to hitting a rock.
reasonFailed			Free text describing reason for failure. Typically generated automatically by the control system using some type of sensors.
Extension			Extension element can include whatever data the users want. The only requirement is that it is well-formed XML i.e. it is tagged
SitePreparation			Structure for site prep positions and data. Can be used also for continuous site preparation.
SitePreparationKey			Specific identity for each site preparation position. Running no recommended, reset only when MachineKey is changed.
MachineAttachment-Key			Attachment specific identity. Running no recommended, reset only when MachineKey is changed.
TrackingKey			Machine unique tracking coordinate identity, set by machine. Must be totally unique for a certain MachineKey.
ObjectKey			Machine specific identity per object. Set when new object is started. Running no recommended, reset only when MachineKey is changed
OperatorKey			Machine unique operator identity, set by machine
SitePreparation-Coordinate			Coordinates for site preparation position.
Extension			Extension element can include whatever data the users want. The only requirement is that it is well-formed XML i.e. it is tagged



Arlinger John

2023-12-21

Log traceability and forwarder reporting

Observe that this is a draft document that will be updated!

Background

The issue of making it possible to report log data also in fpr, rather than only the forwarded volumes, have been briefly discussed at some previous StanForD meetings as well as in more informal settings.

There are at least three strong driving forces for the present proposal:

- Log traceability
- Truck transport management
- Simple and correct forwarder reporting

DIGITAL LOG TRACEABILITY

There is a long history of trying to trace harvested logs from forest to industry, e.g. several EU-funded projects evaluating the use of RFID tags applied to each log with a harvester. There also exists manual systems whereby a paper tag with some code is applied to each log and then read when logs are received at the mill gate. All of these systems are quite complex and expensive, at least from a Northern European perspective where the value of an individual log is often quite low. A different solution could be to use positioning data in combination with GIS-functionality in order to develop what can be described as “digital traceability”. This type of traceability will not give a 100% log traceability. This proposal is one important step towards a solution for having efficient digital traceability from the standing tree to the roadside pile.

A project “Digital traceability from forest to industry” has been started by Skogforsk whereby the possibility of following individual logs from forest to industry is to be evaluated. The project includes using a combination of data from harvesters, forwarders and trucks. Algorithms will be developed and new sensors and controllers for trucks are to be tested.

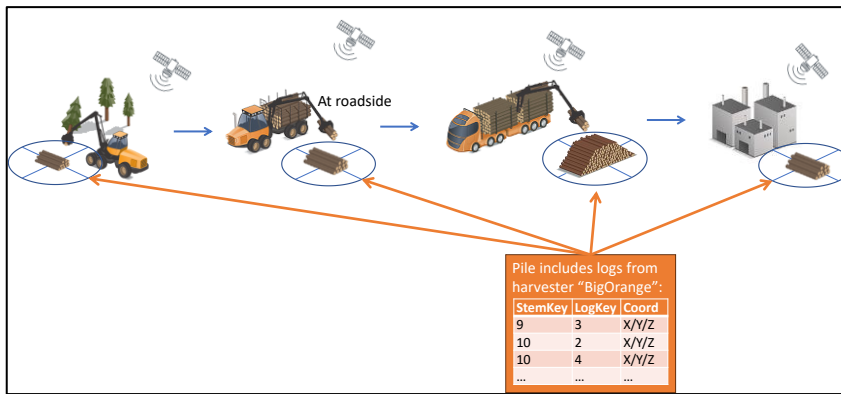


Figure 1. Simplified illustration of digital traceability from forest to industry as covered in the project "Digital traceability from forest to industry".

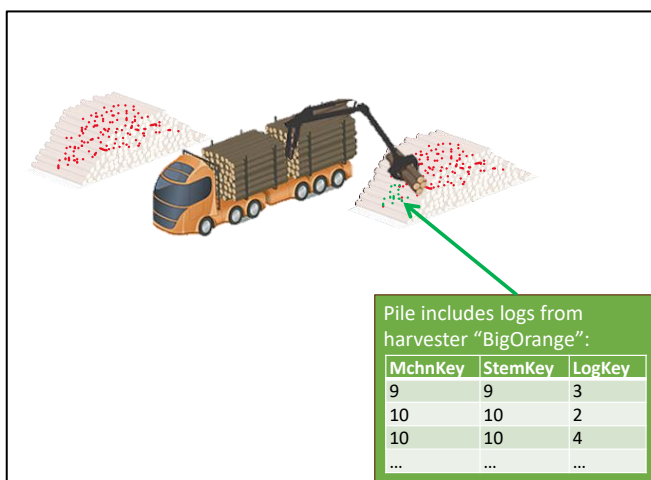


Figure 2. The main objective with the current StanForD proposal is to be able to generate positioning information describing what logs are located in a pile. Observe that we will not know the exact position of each log as the positions are approximated.

TRUCK TRANSPORT MANAGEMENT

Today in Sweden it is common practice to only report forwarded production per landing (one or two Locations per object). The StanForD Location represents a landing. Truck drivers today thus often only have one single position describing approximately where to load logs of a specific Delivery (forwarded assortment). The situation could be improved by creating one Location per Delivery (forwarded assortment). However, it is only possible to registering a single coordinate often representing the position of the forwarder when carrying out the first unloading.

A large proportion of young truck drivers are today not familiar with forestry which means that being able to give more detailed instructions related to what to load or not is an important issue. If it is possible to inform truck drivers about the exact location of the roadside pile including some type of updated pile polygon we would increase loading times, decrease the time it takes to locate a pile and avoid mistakes like transporting the wrong assortments.

IMPROVED FORWARDER REPORTING

Another very important factor behind this proposal is to make it possible to use harvester data as an efficient data source for reporting forwarded volumes without systematic errors. It is common to have systematic errors when using manual estimation of forwarded load volumes, in most cases leading to “under estimations”. Another objective is also to support manufacturers in developing forwarder applications that makes reporting as simple and flexible as possible from an operator perspective whereby each individual load is reported.

Future forwarder reporting could probably be based on the following data sources:

- Log pile positions from harvester registered according to hpr-format in combination with forwarder positioning.
- Grapple positioning when picking up logs from the ground and laying down logs in a pile.
- Automatic determination when opening and closing grapple (moving logs)

Combining the information mentioned above and GIS-functionality should make it possible to have a situation where the operator only needs to give the following input for each load cycle (driving from landing - loading in forest - driving to landing - unloading at landing):

- Confirmation of semi-automatically selected roadside pile when unloading where each pile has a reference to a single Location and a single Delivery.

The basic method for estimating and registering the forwarded volume could be:

- 1) Automatically calculate “loading zones” which includes the approximate polygons where logs have been laid on the ground by the harvester. The polygons are created based log positions (hpr), information about activity in the grapple and the position of the grapple.



- 2) Automatic suggestion of a roadside pile (referencing a Location and a Delivery) based on distance from where logs are unloaded. Information about activity in the grapple and the position of the grapple is used in order to estimate where logs are positioned after unloading.
- 3) All harvested logs within the “loading zones” that are included among the operator selected Delivery are used for calculating the total volume per PartialLoad. This requires that the same ProductUserIDs are used by the harvester (hpr) and by the forwarder (per Delivery in fdi).

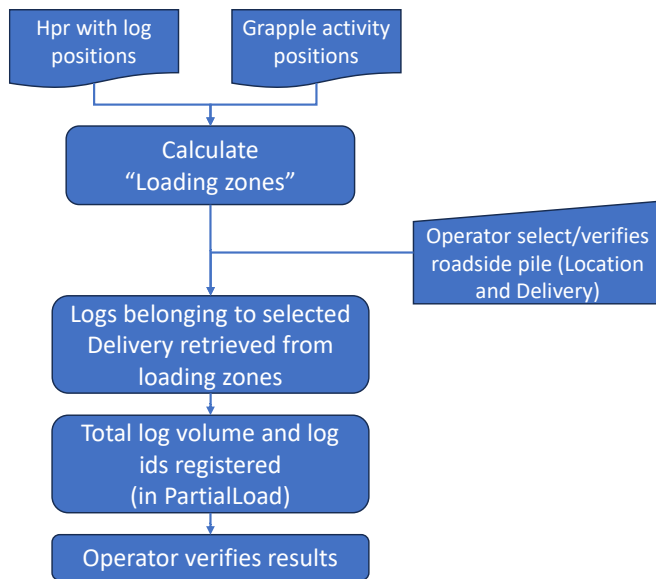


Figure 2b. Flow chart illustrating the basic method as described above.

Introduction

It is probably a good idea to utilize the fpr schema (ForwardingProductionReport) if we are to convey approximate log positioning data including unique identities.

Today the StanForD structure/concept of Location is normally used to represent a landing consisting of a road segment with a large number of different roadside piles. Each roadside pile typically includes one assortment that is to be delivered to one mill (a Delivery).

It is possible to let a Location represent a roadside pile rather than a landing. This would make it possible to describe the content of an individual pile in a much more efficient way, as illustrated in figure 2. The StanForD standard probably does not need any structural modifications if we assume that a Location represents one pile and that each Location only include one single Delivery.

To utilize the proposal in an efficient way it is also assumed that the harvester can generate accurate position data for each log and that both harvester and forwarder is equipped with tools to position the head and the grapple.

The possibility of including log positions in the hpr-message was included with version 4.0. However, the structure can easily be included in older schema versions using the Extension element.

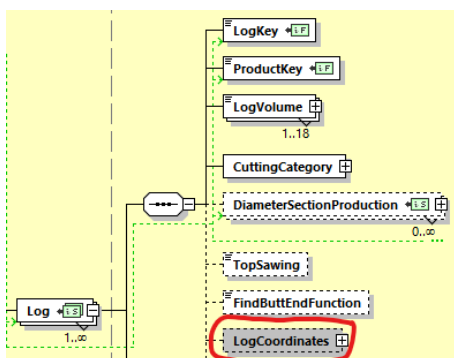


Figure 3. New element in hpr schema with version 4.0 whereby the coordinates of the harvested logs can be reported.

A new element “LoadChange” was added to the fpr-file with version 4.0. This new element was added to make it possible to monitor when logs are loaded or unloaded. However, it is probably a good idea to view this structure as deprecated if the included new proposal is added to the standard.

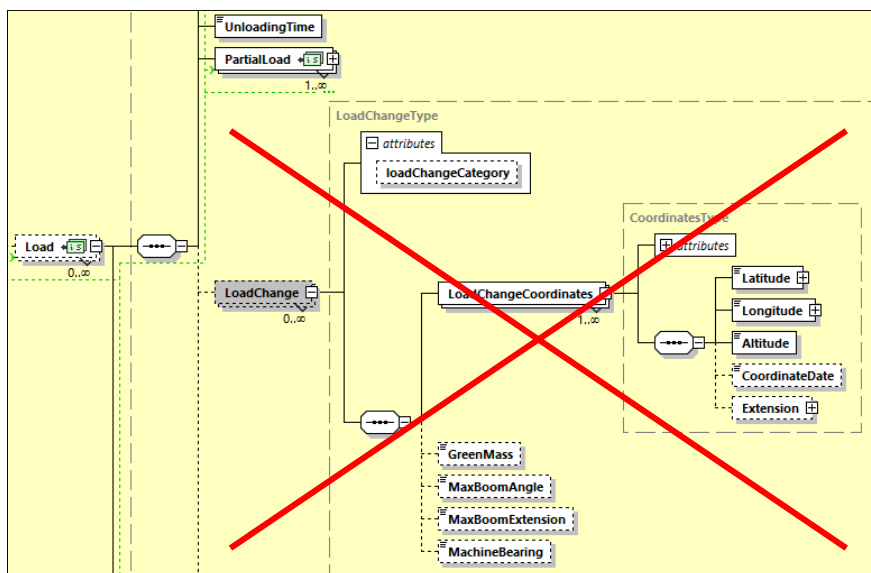


Figure 4. Deprecated structure

The aim is to have a system that is based on registering log information when unloading the logs in a pile or in some cases in the forest (outside a roadside pile). The proposal can thus be viewed as adding a new “tracking” structure describing how logs are transported.

Proposal for log IDs in fpr

UPDATES TO FPR

It is proposed to include a new structure in the fpr-file (figure 5, 6) whereby it is possible to describe what logs were transported with a load and approximate positions where the logs have been unloaded. Observe that figure 6 illustrates that LogReference is now repeatable.

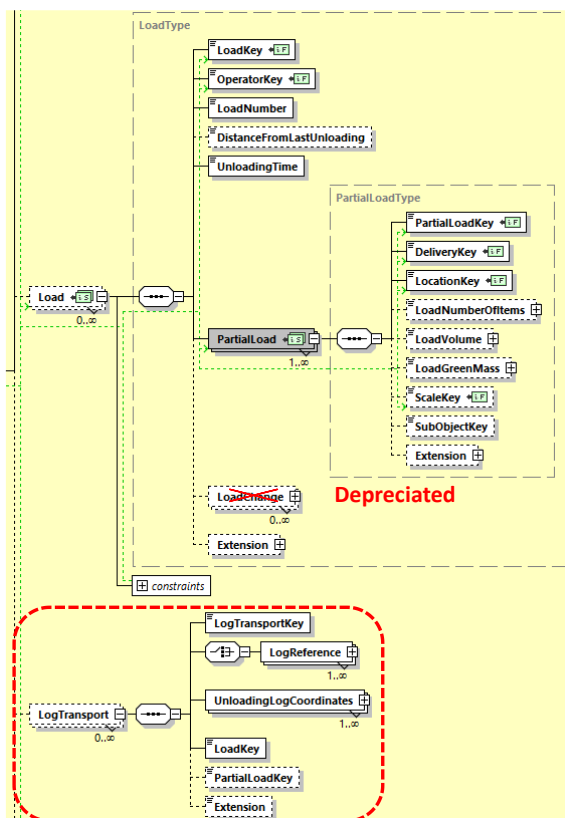


Figure 5. New structure LogTransported in fpr-schema.

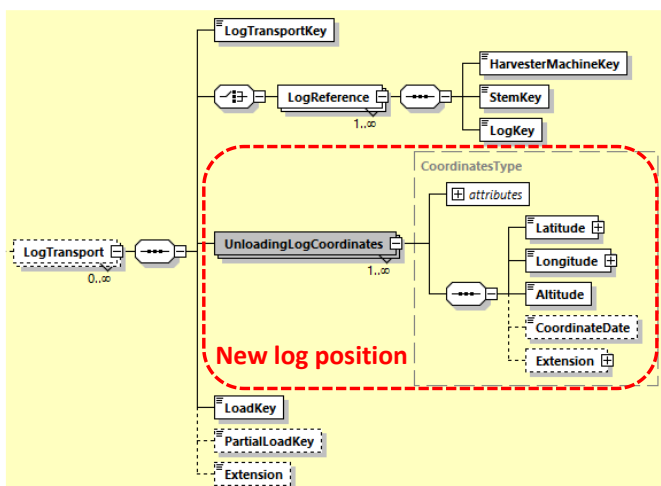


Figure 6. Detailed illustration of the new LogTransport structure, including positions where logs are unloaded and identities of the logs. This structure could be viewed as a “log tracking structure”.

Tabel 1. Description of suggested new elements

Name	Data type	Unit	Description
LogTransport			Structure for reporting the position where harvested logs have been moved by a forwarder.

Name	Data type	Unit	Description
			No PartialLoadKey to be registered if logs are unloaded outside a Location (normally in the forest).
LogTransportKey	unsignedLong	Seq. no	Machine specific identity per log transport. Must be totally unique for a certain MachineKey. Reset only when MachineKey is changed
LogReference			Structure for unique log references extracted from hpr-file.
HarvesterMachineKey	String		Globally unique harvester identity (GUID). Extracted from hpr message.
StemKey	unsignedLong		Harvester specific identity per stem. Extracted from hpr message.
LogKey	unsignedLong		Stem specific id for log. Running number reset for each stem. First log (butt end) always LogKey=1. Extracted from hpr message.
UnloadingLogCoordinates	CoordinatesType		Coordinates describing the position of logs unloaded in a specific Location or outside any Location. Child elements and attributes defined according to the basic CoordinateType
LoadKey	unsignedLong		Machine specific identity per load. Must be totally unique for a certain MachineKey. Reset only when MachineKey is changed. In this case used as a reference to a Load.
PartialLoadKey	unsignedLong		Machine specific identity per partial load. Unique inside Load. In this case used as a reference to a PartialLoad.

EXAMPLES

Below are a couple of different use cases that were created to illustrate how the new proposed standard solution could be implemented. Observe that there is no plan to implement any strict rules regarding possible algorithms or the functionality of the user interface.

Use case 1 - First load at harvesting object (no existing Locations)

The first example describes the fact that the operator must create a new Location when unloading at a new roadside pile for the first time (figure 7). The idea is that the forwarder controller, based on signals from the crane and the grapple, creates “loading zones”. When starting to unload, the operator must select which type of Delivery that the pile includes. Observe that each Delivery has references to one or several harvested Products. These references (one or several ProductUserIDs per Delivery) together with the “loading zones” can be used to calculate what logs have been loaded and thereby also unloaded on the selected Location. All logs are each given an approximate coordinate in the pile at roadside.

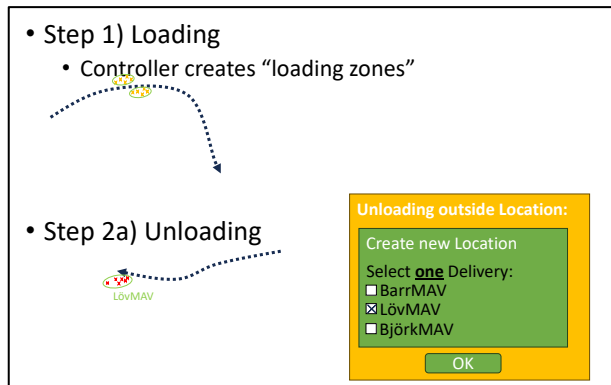


Figure 7. Illustration of use case 1 where the operator defines a new Location (pile) and the content of the pile (one single Delivery).

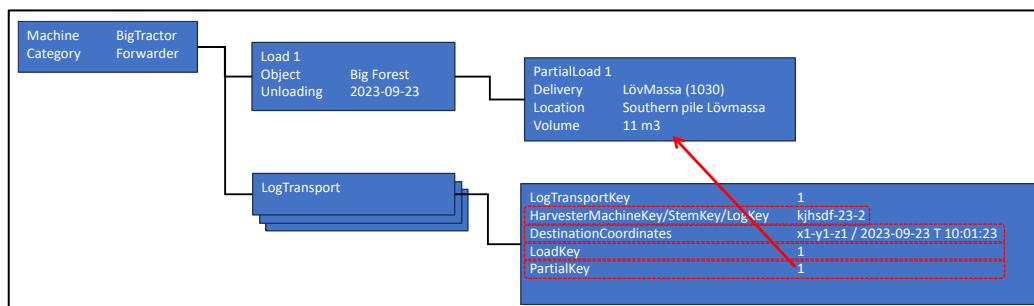


Figure 8. Data structure for reported volumes and logs.

Observe that the LocationCoordinate should represent the centre of the pile. Attribute receiverPosition should therefore not only include enumeration “Base machine”. The enumeration value “Product position” or “Attachment center” should in the future be included based on either boom positioning data or manual input through a GIS interface.

Use case 2 - Unloading at existing Locations

The forwarder automatically estimates the logs and the piles during unloading. Logs are thus “virtually moved” from the loading zones to the piles. Figure 9 illustrates (step 4) that the operator should be able to move logs belonging to one harvested product into a pile that is specified for a Delivery referencing different products. This is a common situation if the total available volume of a harvested product is too small to carry the transportation costs or there is an urgent market demand for another product.

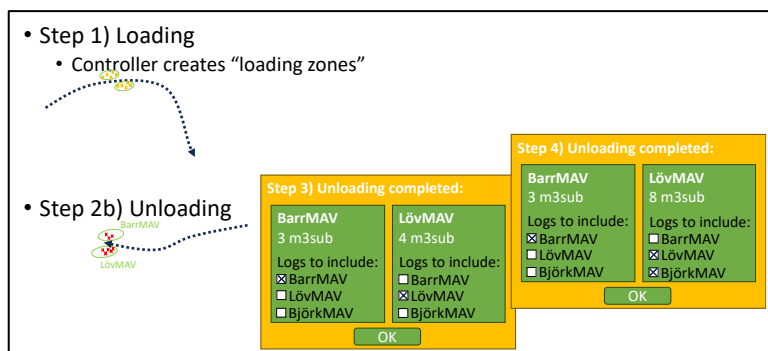


Figure 9. Illustration of use case 2 where the operator verifies the automatically calculated volumes with a modification in order to include also logs belonging to harvested product BjörkMAV into delivery LövMAV.

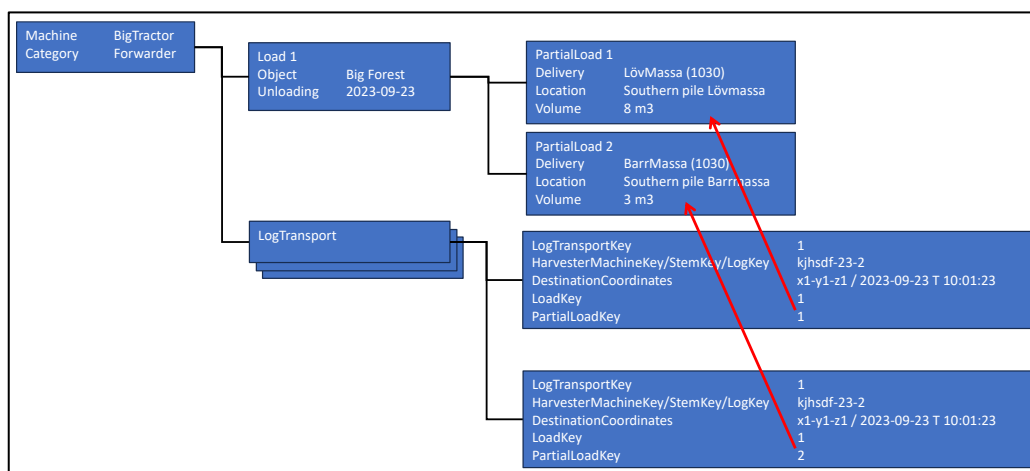


Figure 10. Data structure for reported volumes and logs when co-loading separate products.

Use case 3 - Overlapping Locations

The forwarder automatically estimates the logs and the piles during unloading. Logs are thus "virtually moved" from the loading zones to the piles. However, the piles may in certain situation overlap each other, e.g. if a truck has removed part of the pile. The operator should in these cases be able to specify which location (pile) is the true one.

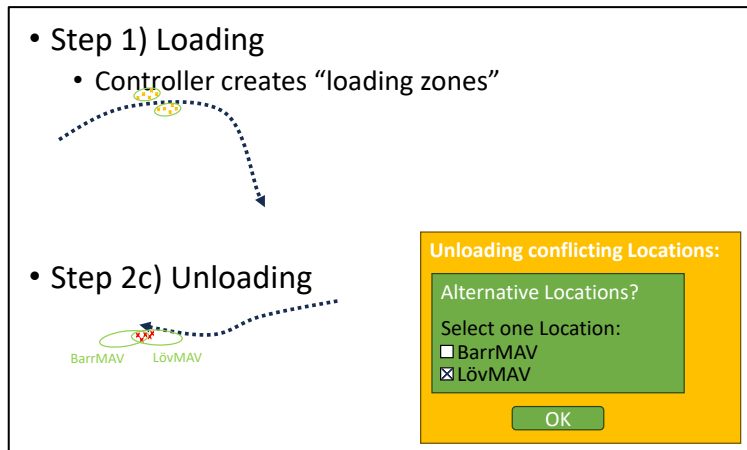


Figure 11. Illustration of use case 3

Use case 4 - Outside existing Locations

The forwarder automatically estimates the logs and the piles during unloading as described above. However, the logs may be unloaded in between two existing piles. The operator should in these cases be able to specify which location (pile) is the true one or if a new location must be created. This use case is thus more or less identical with the previous use case.

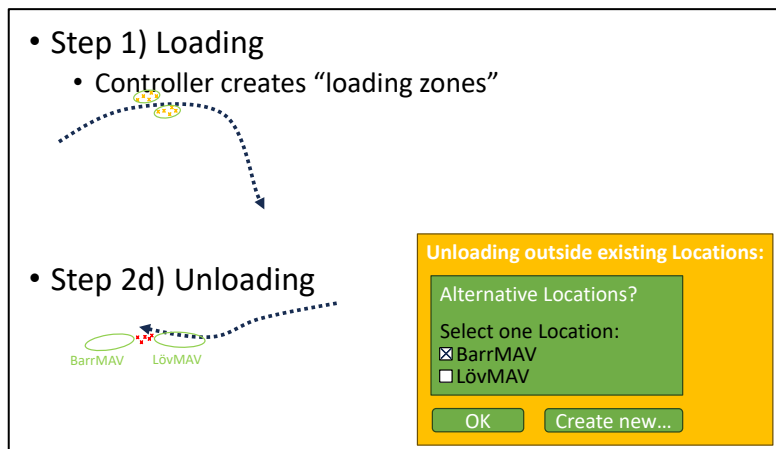


Figure 12. Illustration of use case 4

Use case 5 - Unloading in forest (far from Locations)

The forwarder automatically estimates the logs and the piles during unloading as described above. However, some logs may be unloaded in the forest outside any existing pile. The operator should in these cases be able to specify that a specific harvested product has been unloaded in the forest (outside any piles).

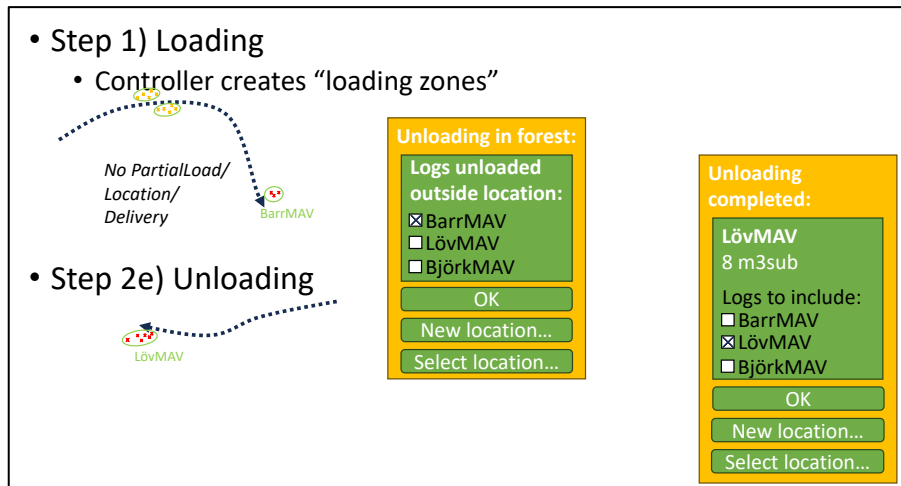


Figure 13. Illustration of use case 5

The new suggested data structure (figure 14) allows for reporting log data without any reference to a partial load. A LogTransport element without a reference to a partial load does not belong to any delivery or location. This means that these logs have, to put it simply, only been moved from one position to another position (red structure in figure 14).

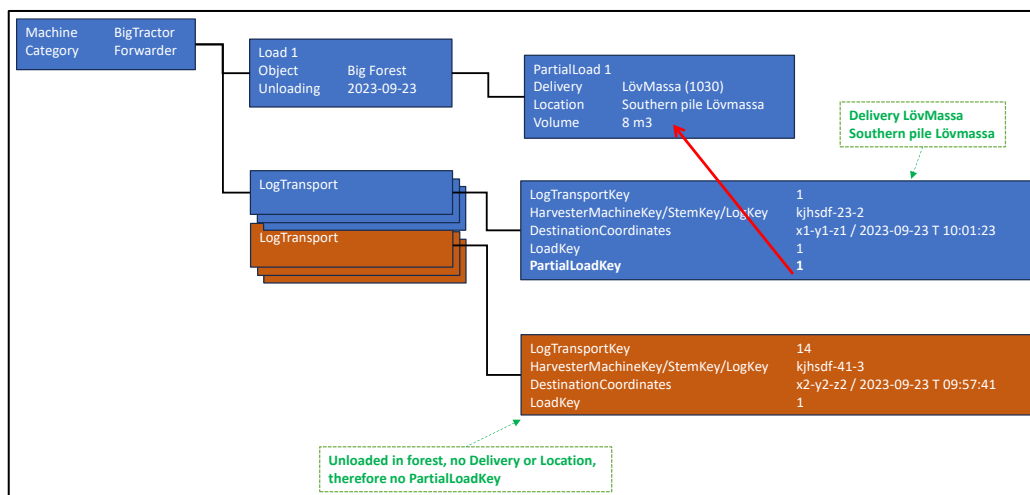


Figure 14. Data structure for reported volumes and logs when co-loading separate products.

Use case 6 - Moving logs from one pile to another pile

Another use case could be when there is a need to move logs from one location (pile) to another location (pile). This may occur if a road side pile is too small in order to be commercially viable due to high transportation costs for marginal volumes. Another reason might be in cases when a private forest owner wants to keep a limited volume of logs for fuel wood.

It should thus be possible for the operator to register that a volume of one location is reduced while another the volume of another location is increased. It is important that the total reported volume of a specific location is never to be negative.

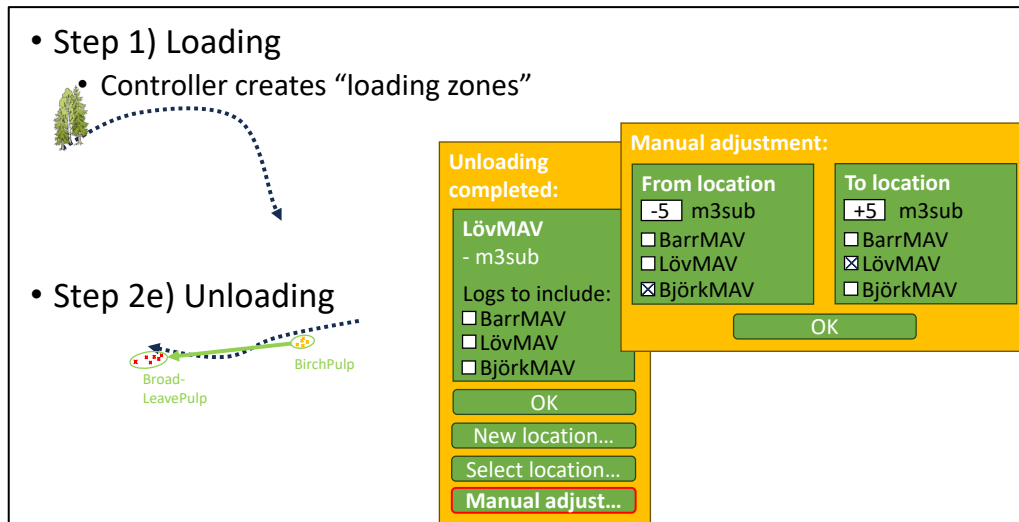


Figure 15. Illustration of use case 6

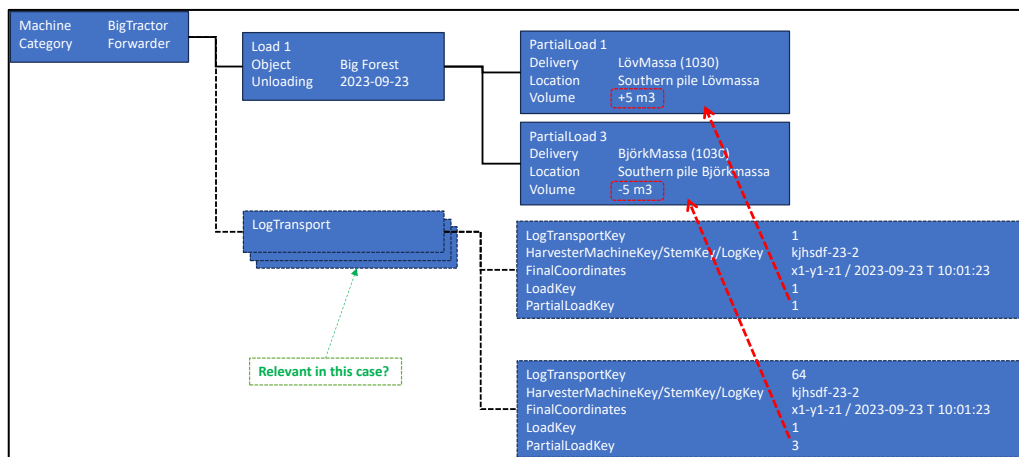


Figure 16. Data structure for reported volumes and logs when moving logs from one pile (location) to another. Observe that LogTransport is optional and may in some cases be irrelevant in this type of situation.

RETRIEVING IDENTITIES AND VOLUMES OF LOGS

The objective of this section is to try to illustrate how log identities generated by the harvester and registered in an hpr-file may be retrieved in order to be registered in the new LogTransport structure. Figure 17-19 could be described as a visual step-by-step illustration from a forwarder perspective when starting to unload logs.

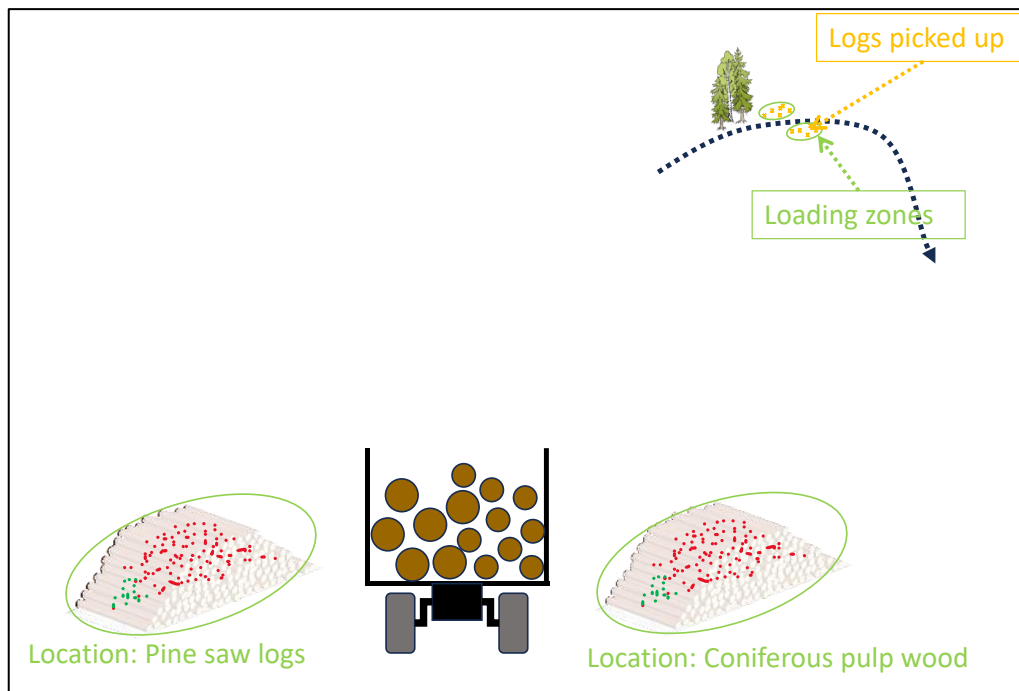


Figure 17. A forwarder arriving at roadside to unload logs in either of two locations (roadside piles). The positions of all harvested logs are known to the forwarder controller and so called "Loading zones" created based on where logs were picked up since previous "unloading activity" was completed.

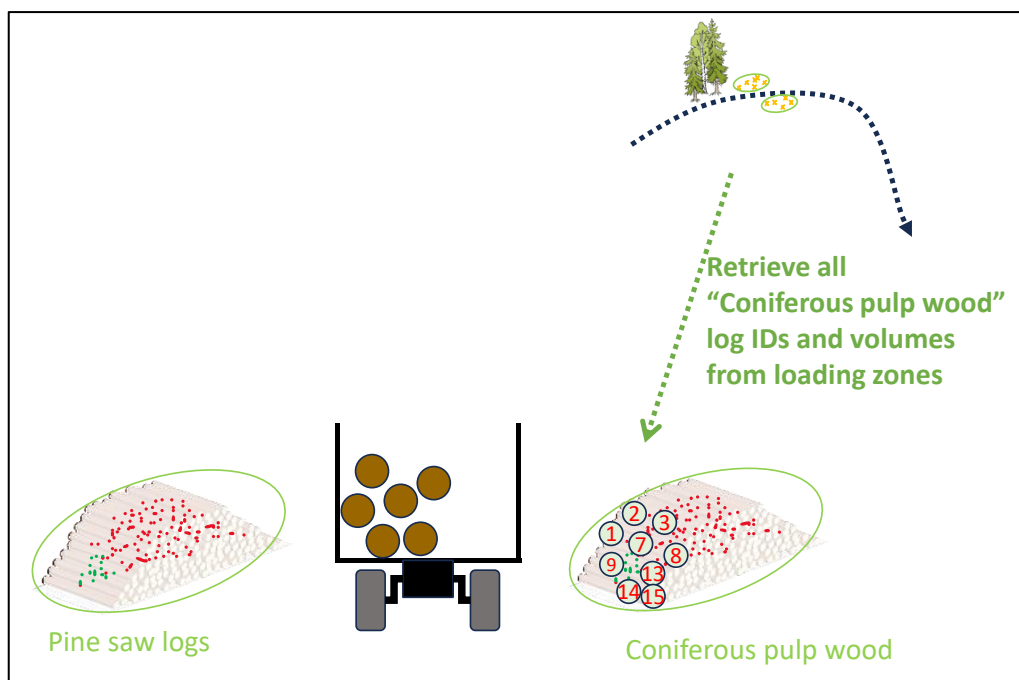


Figure 18. Once logs have been unloaded into a known Location polygon the controller automatically retrieves all logs referenced through the ProductUserID found under the DeliveryDefinition of the Location. In this example all "Coniferous pulp wood logs" found in the loading zones are added to the LogTransport structure including the approximate coordinates in the pile.

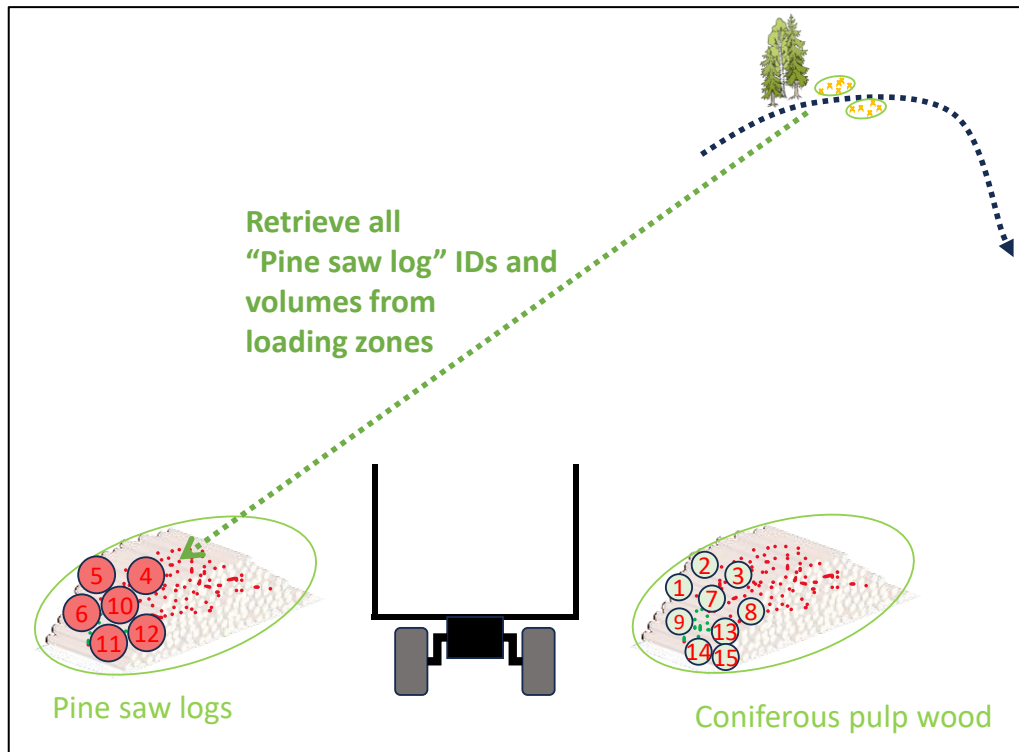


Figure 19. All “Pine saw logs” found in the loading zones added are added to the LogTransport structure including the approximate coordinates in the roadside pile. Observe that the log identities are unknown until the logs are unloaded onto a Location (pile).

Proposal for crane cycle segments in mom

The possibilities to also register where logs were picked up was discussed within the “Digital traceability” project. The primary objective being to be able to evaluate and develop the algorithms for creating the so called “loading zones”. However, this type of information would also be relevant information when analysing the forwarding work from both a productivity and ground damage perspective. A first idea was to include this information within the Tracking structure which is available in both fpr and mom. However, this is information that could be used when studying productivity and thus means that this type of data is not suitable for the fpr-file.

Another advantage with this type of data is that it gives the possibility to continuously calibrate route optimization software, that is software used for planning forwarding operations.

In short, this new structure would make the mom-file much more relevant for detailed analyses of forwarding work.

A possible solution could be to register when different types (segments) of forwarder movements begins and ends. Additionally, it would be a significant advantage to open the possibility to register when the boom is active within a specific segment as illustrated in figure 20. A full picture of the forwarding work can be extracted if this information is referenced from the Tracking structure.

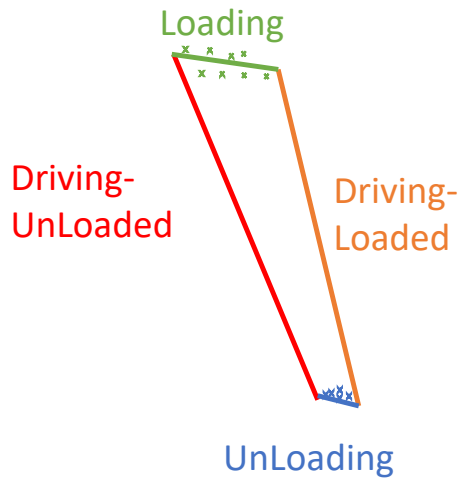


Figure 20. Illustration of forwarding work data during one load cycle. Crosses symbolises where boom activity has been registered.

It is therefore suggested that we open the possibility to include a new structure for registering boom activities in order to evaluate different types of algorithms. The new suggested update to the mom schema is illustrated below in figure 21 and table 2.

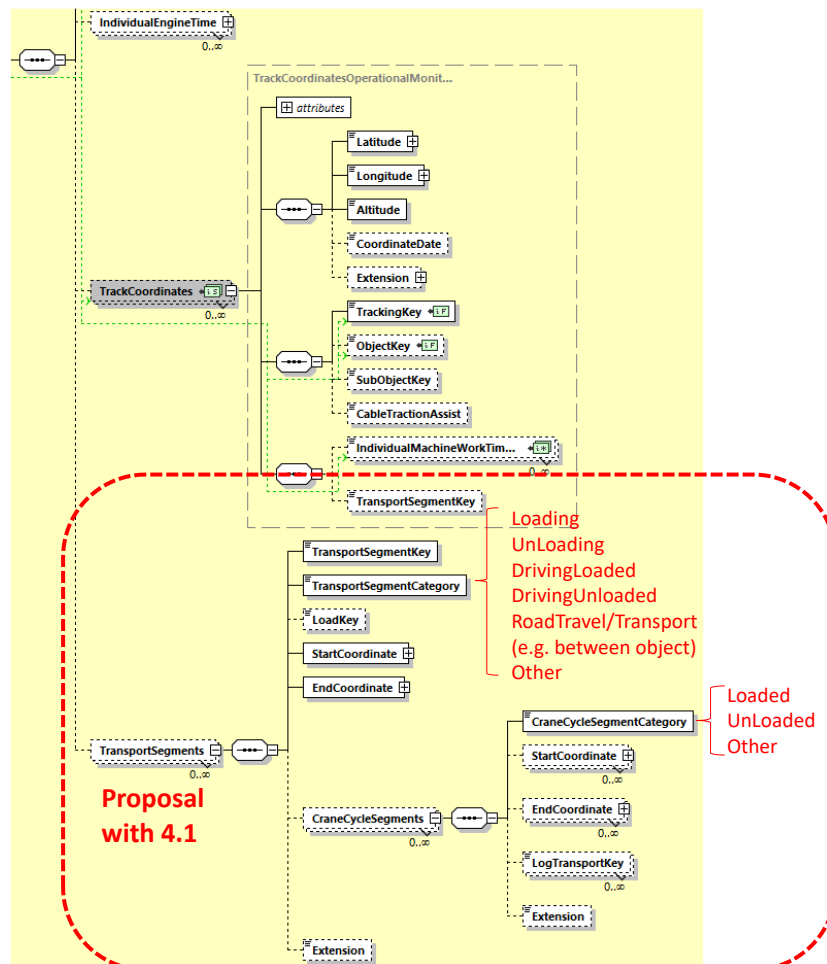


Figure 21. Structure for proposed new transport segments.

Tabel 2. Description of suggested new elements

Name	Data type	Unit	Description
TransportSegments			Structure for reporting different transport segments where e.g. one segment is the start and end point of driving unloaded from roadside to the forest.
TransportSegmentKey	Unsigned-Long		Machine specific identity per transport segment. Must be totally unique for a certain MachineKey. Reset only when MachineKey is changed
TransportSegment-Category	string	enum	Type of transport segments. Allowed values are: "Loading", "Unloading", "DrivingLoaded", "RoadTravel", "Other"
LoadKey	Unsigned-Long		Machine specific identity per load. Must be totally unique for a certain MachineKey. Reset only when MachineKey is changed. In this case used as a reference to a Load in an fpr message.
StartCoordinate	Coordinates-Type		Coordinates describing the position where a TransportSegment started. <u>Child elements and attributes defined according to the basic CoordinateType.</u>
EndCoordinate	Coordinates-Type		Coordinates describing the position where a TransportSegment ended. <u>Child elements and attributes defined according to the basic CoordinateType.</u>
CraneCycleSegments			Structure for reporting of crane cycle data for each transport segment. A CraneCycleSegment starts and ends when logs are first picked up or released.
CraneCycleSegment-Category	string	enum	Type of crane cycle segments describes position of grapple when starting and ending a cycle. Allowed values: "Loaded", "Unloaded", "Other" Typically, this means that one complete loading cycle is started with one segment category "Unloaded" and ending with a segment category "Loaded".
StartCoordinate	Coordinates-Type		Coordinates describing the position where a CraneCycleSegment started. <u>Child elements and attributes defined according to the basic CoordinateType</u>
EndCoordinate	Coordinates-Type		Coordinates describing the position where a CraneCycleSegment ended. <u>Child elements and attributes defined according to the basic CoordinateType</u>
LogTransportKey	Unsigned-Long		Machine specific identity per LogTransport. Optional. Must be totally unique for a certain MachineKey. Reset only when MachineKey is changed. In this case used as a reference to a LogTransport in an fpr message.

Relative limitation matrix

Why this is needed:

1. Over production of dimensions with BuckingCriteria "Only logs bucked manually allowed". Let's take an example where forest company target is 5% of logs per diameter class for "Only logs bucked manually allowed". In real life the result can in many cases be something else. In following sample "Only logs bucked manually allowed" for lengthclass 370 and diameterclasses 220-360 result of logs per diameterclass is between 11,7% and 28,9%.
2. Possibility to use limitation also in large volume companies. This makes it easier to control distribution for companies having several harvester for each destination. Company can send same relative limitation to all harvesters. In current limitation solution it's not possible or at least it's very complex to handle.
3. Possibility to optimize cutting with simulator and get corresponding results in forest. Replacing BuckingCriteria "Only logs bucked manually allowed" dimension with relative limitation we make it possible for operator in harvester cut more logs with automation, results are more predictable and optimized PINs are working correctly in forest.

Testing relative limitation matrix with Ponsse simulator and Valueforce

Ponsse implemented support for relative limitation matrix to simulator component used in Valueforce. Valueforce will write relative limitation to PIN files before simulation (Only selected PINs with BuckingCriteria "Only logs bucked manually allowed") and extension for simulator to get relative limitation used. At first we took couple of already harvested workingsites with large volume and inspected PIN used in harvesting. Then we simulated same workingsites with PINs used in harvesting. Everything else was exactly same way like in harvesting but Test pin's BuckingCriteria "Only logs bucked manually allowed" dimensions were replaced with relative limitation 5 (number of logs per diameterclass per product), Bucking criteria was replaced with "No limit".

Settings:

```
<Extension>
  <Ponsse xmlns="http://www.ponsse.com">
    <RelativeLimitationExtension>
      <RelativeLimitation RelativeLimitationStart="1">true</RelativeLimitation>
    </RelativeLimitationExtension>
  </Ponsse>
</Extension>

<LimitationDefinition modificationRestricted="false">
  <LimitationCategory>Number per diameter class per product</LimitationCategory>
<LimitationResult>Production is stopped, forbidden to buck logs including manual bucking
of logs</LimitationResult>
</LimitationDefinition>

<ProductMatrixItem diameterClassLowerLimit="240" lengthClassLowerLimit="370">
  <Price>110</Price>
  <Distribution>0</Distribution>
  <Limitation>5</Limitation>
  <BuckingCriteria>No limit</BuckingCriteria>
```

Then we compared results with harvesting and simulation with relative limitation matrix. Results are shown below.

Jakaumataulukko

Pituus cm Läpimitta mm	370	%
150	-1	0
160	-1	0
165	-1	100
180	-1	100
200	-1	100
220	-2	100
240	-2	100
250	-2	100
260	-2	0
280	-2	100
300	-2	100
320	-2	100
360	-2	100

Muokkaus

Päivitä jakaumaa

0

[OK] [Cancel]

Jakaumataulukko

Pituus cm Läpimitta mm	370
150	0
160	0
165	0
180	0
200	0
220	1
240	1
250	1
260	1
280	1
300	1
320	1
360	1

Results from harvester

Simulointiajo - VF_182-1		Lohko - H100104990101					
Hakkuukone PTL							
Hakkuukone PTL	Määrä, m3	%/m3	Pölkyt, kpl	%/kpl	Keskijäreys, dm3	Keskipituus, m	Keskiläpimitta, mm
	102,6	10,5	843	13	122	4,84	154
	33,1	3,4	205	3,2	162	5,01	180
	171,5	17,6	623	9,6	275	4,45	251
	349,5	35,9	1718	26,5	203	4,75	214
	39	4	200	3,1	195	2,59	282
	271,4	27,9	2814	43,4	96	4,61	122
	6,4	0,7	86	1,3	75	2,7	141
Yhteensä	973,6	100	6489	100	150	4,59	169

Jakauma, %/kpl																			
		Keskipituus 442 cm				Keskijäreys 265 dm			Keskiläpimitta 249 mm			Jakauma-aste 73,36 %							
Pituus cm	Läpimitta mm	370													%	kpl	%/kpl	m3	%/m3
150	0														0	0	0	0,0	0
160	0														0	0	0	0,0	0
175	0														100	7	1,1	0,9	0,5
180	0														100	7	1,1	0,9	0,5
200	0														100	93	14,4	16,0	9,3
220	11,7														100	196	30,2	44,3	25,7
240	20,6														100	63	9,7	16,7	9,7
250	18,3														100	71	11,0	20,9	12,1
260	28,9														100	83	12,8	24,0	13,9
280	14,3														100	84	13,0	29,6	17,2
300	19,4														100	31	4,8	12,5	7,3
320	23,1														100	13	2,0	6,3	3,7
360	0														0	0	0	0,0	0
kpl	94		67	113	86	96	82	70	40	648	6...	100 %	17...	100 %					
%/kpl	14,5		10,3	17,4	13,3	14,8	12,7	10,8	6,2	100 %									
m3	22,3		10,8	21,9	26,2	28,8	26,3	23,2	12,6	172,1									
%/m3	13,0		6,3	12,7	15,2	16,7	15,3	13,5	7,3	100 %									

Results from simulation with relative limitation matrix.

Simulointiajo - VF_182-2

Lohko - H100104990101

Hakkuukone PTL

Hakkuukone PTL	Määrä, m3	%/m3	Pölkkyt, kpl	%/kpl	Keskijäreys, dm3	Keskipituus, m	Keskiläpimitta, mm
	171,5	17,6	623	9,6	275	4,45	251
	33,1	3,4	205	3,2	162	5,01	180
	349,5	35,9	1718	26,5	203	4,75	214
	271,4	27,9	2814	43,4	96	4,61	122
	39	4	200	3,1	195	2,59	282
	6,4	0,7	86	1,3	75	2,7	141
	102,6	10,5	843	13	122	4,84	154
Yhteensä	973,6	100	6489	100	150	4,59	169

Simulointiajo - VF_182-2

Jakauma, %/kpl

		Keskipituus 445 cm			Keskijäreys 275 dm		Keskiläpimitta 251 mm			Jakauma-aste 73,78 %					
Pituus cm	370										%	kpl	%/kpl	m3	%/m3
150	0										0	0	0	0,0	0
160	0										0	0	0	0,0	0
165	0										100	1	0,2	0,1	0,1
180	0										100	2	0,3	0,2	0,1
200	0										100	89	14,3	15,3	8,9
220	0										100	194	31,1	42,8	25,0
240	5,4										100	56	9,0	15,3	8,9
250	4,5										100	66	10,6	20,0	11,7
260	4,3										100	69	11,1	21,1	12,3
280	2,2										100	93	14,9	33,3	19,5
300	2,6										100	39	6,3	16,3	9,5
320	0										100	14	2,2	6,8	4,0
360	0										0	0	0	0,0	0
kpl	12	97	125	102	104	84	69	30	623	6...	100 %	17...	100 %		
%/kpl	1,9	15,6	20,1	16,4	16,7	13,5	11,1	4,8	100 %						
m3	2,9	17,0	24,9	32,3	33,6	27,5	23,7	9,3	171,2						
%/m3	1,7	9,9	14,5	18,9	19,6	16,1	13,8	5,4	100 %						

Results in Harvester compared to results in simulator with relative limitation matrix

	Harvesting	Simulation with rel. lim. matrix
Total volume	969,7	973,6
Sawlog volume	690,6	695,8
Sawlog %	71,2	71,5
Distribution percentage	73,36	73,78
Total volume of Manual cutting dimensions	22,3	2,9

Test run 2: 5 worksites totally 5500 m3 of pine, only summary presented

	Harvesting	Simulation with rel. lim. matrix
Total volume	5498,4	5578,4
Sawlog volume	3735,8	3842,8
Sawlog %	67,9	68,8
Distribution percentage	69,95	71,10
Total volume of Manual cutting dimensions	115,7	43,4 (There was 1 worksite where 370/260 was not manual cutting and limited -> extra 15 m3 in one dimension)

Results of testing

- Relative limitation works as expected: BuckingCriteria “Only logs bucked manually allowed” dimensions volume decreased to the desired level.
- Distribution percentage get higher compared to manual cuttings
- The amount of sawlogs increased compared to harvester volumes. This was positive surprise. We would have been satisfied if it had remained the same level.
- Because results were good this makes it possible to use limitations also in bigger companies by effective way.

In summary relative limitation matrix is effective tool to decrease volume of unwanted dimensions without unwanted side effects like decrease of sawlog total volume. Also distribution percentage gets better. And last but not least this makes it possible to optimize PINs with simulator and move optimized PINs to harvester with no changes. So let's move this to standard