



Arlinger John

27 April 2023

Minutes StanForD

2023-04-27

Place:	Uppsala/Teams, 2023-04-26--25, 12:00-12:00 EET
Participants:	John Arlinger, Secretary Johan J. Möller, Chairman Fredrik Tjernberg, Komatsu Tapio Räsänen, Metsäteho Timo Melkas, Metsäteho Antti Korkiakoski, JohnDeere Heikki Komulainen, Ponsse Henrik Persson, LogMax Mike O'Shea, Coillte Conor Barry, Coillte Antti Happonen, Coillte Aapo Koskela, Logset <u>Attending through Teams:</u> Americo Patetta, Roman-group Asko Leivonmäki, Exertus/Logset Hristo Hristoskov, EcoLog Ian Wilson, PHD Forest Jaakko Mäkinen, Technion Jan Rosdahl, Otmeka Jean Plamondon, FP Innovation Jonas Thorsson, Dasa Lars Henriksson, Biometria Janne Pursiainen, Ponsse Anders Rowell, Skogforsk Juha-Antti Sorsa, Metsäteho Tom Boye, Otmeka Roger Vahlberg, EcoLog (day 1) Jonas Gustafsson, Sveaskog (day 1) Jeremy Gibson, PHD Forest (day 1) Andreas Barth, CGI (day 1)

	Bobby Sz wajkowski, Tigercat (day 1) Christophe Ginet, ONEF (day 1) Hans-Ulrich Dietz, Univ. Friburg (day 1) Juha Käppi, Trimble (day 1) Jyrki Vainio, Trimble (day 1) Louis-Vincent Gagne, FP Innovation (day 1) Hannrup Björn, Skogforsk (day 2) Whillans Martin, Skogforsk (day 2) Josh Hildebrand, Tigercat (day 2)
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Decision summary

Decided to do the following schema updates in version 4.1:

- Element name ShifKey changed to ShiftKey in DataTableGroupOperationalMonitoringType and OperatorWorkTimeType as well as in two constraints in mom schema. The following comment will be added to the updated mom schema *“Observe that it was decided 2023-04-27 to correct two element names ShiftKey without updating schema version and date”*.
- The term “base diameter for extrapolation” and abbreviation D_{base} is to be used for ButtEndExtrapolation elements.
- New element DisruptedMeasuring with attribute disruptedMeasuringDescription added to LogType
- Add a new element TopRenderingOrder and to make TopRendering repeatable in the ogi and ogr schemas.

Conclusions from discussions:

- Study how to handle “point/feature of interest” rather than extending the use of StemCodes, perhaps using ogr.
- Study new enumerations in attribute qualityIndicatorGNSSType and new data type for DegreeType (from *from nonNegativeInteger to nonNegativeDecimal*)
- Recommended that users of e.g. Silvia and ForesterOffice are always reminded to fill in at least a company name for LoggingOrganization in order to avoid having an empty LoggingOrganisation structure in instruction files.
- Questionnaire regarding non-registered (discarded) butt-offs to be sent out prior to next meeting.
- Recommendation when implementing stem codes in harvester controllers:
 - Suggested to make it simple for the operators to move StemCodes upwards or downwards in order to have the most commonly used codes at the top.

- Any change in ordering of stem codes is to be kept permanently in order to avoid having to update the presentation order when e.g. starting a new site.
- It is deemed relevant to have the possibility to register stem-codes also for felled and multi-tree-processed stems.

Action list:

- Recommended that users of administrative tools for generating instruction (e.g. Silvia and ForesterOffice) are always reminded to fill in at least a company name for LoggingOrganization in order to avoid having an empty LoggingOrganisation structure in instruction files.
- Recommendation when implementing stem codes in harvester controllers:
 - Suggested to make it simple for the operators to move StemCodes upwards or downwards in order to have the most commonly used codes at the top.
 - Any change in ordering of stem codes is to be kept permanently in order to avoid having to update the presentation order when e.g. starting a new site.
 - It is deemed relevant to have the possibility to register stem-codes also for felled and multi-tree-processed stems.
- 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.

§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.

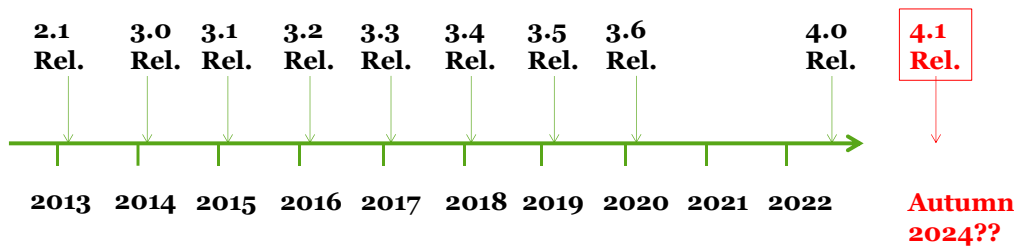
§3 Information about decisions and discussions at previous meetings

Main decisions and conclusions at last meeting (2022-11-16):

- Correct volume and mass types for the fpr schema allowing also negative decimal numbers for partial loads.
- Description of element FillStyle is to be updated in version 4.1
- Add new mandatory GISCoordRefSystem attribute also to the background maps (element BackgroundMap) in version 4.1.
- No objections were raised when the secretary recommended that version 2 is excluded when devesloping new applications supporting 4.0.
- A concrete API proposal with a number of examples is probably needed to start working on a data API. Another comment was the this would be a “huge task” comparable with developing a new standard.

§4 Future frequency of StanForD updates

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



The secretary stated that there is probably no reason for publishing a new version 4.1 until a significant number of manufacturers have started to implement the 4.0 version since this is basically the only way to safely find possible bugs and errors. The conclusion was therefore that a new 4.1 version is probably not to be implement before November 2024.

When discussing the time frame for implementation of 4.0 most manufacturers estimates that it will not be available on the market before 2024. No concrete implement schedules were presented at the meeting. However, at least one manufacturer indicated that they probably will start implementing ogi according to 4.0 within the coming the next year.

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

§5 Reporting of issues related to new version 4.1

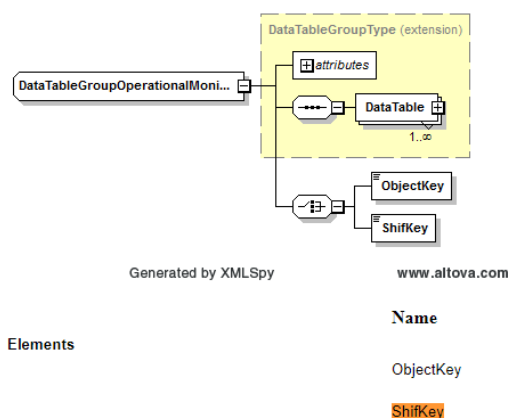
SHIFTKEY SPELLING ERROR

A spelling error in element ShiftKey under OperatorShiftDefinition was corrected with version 4.0.

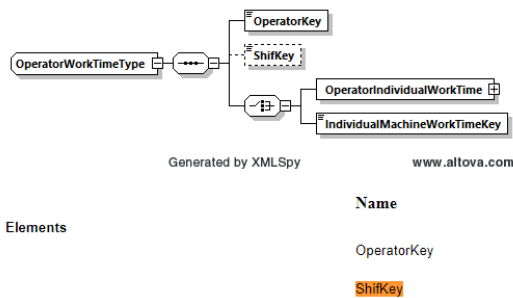
However, it has been noted by Katri Palmroth, JohnDeere (2023-03-16) that this correction was not done in DataTableGroupOperationalMonitoringType and in OperatorWorkTimeType.

DataTableGroupOperationalMonitoringType

Base type: [DataTableGroupType](#)



OperatorWorkTimeType



From a strict standardization perspective these errors should not be corrected until version 5.0. However, we did make a similar adjustment to 4.0 after the meeting in November (LoadMass and LoadVolume now allows for negative values).

It was decided to update the 4.0 mom schema with element name ShiftKey changed to ShiftKey in DataTableGroupOperationalMonitoringType and OperatorWorkTimeType as well as in two constraints. The following comment will be added to the updated mom schema “Observe that it was decided 2023-04-27 to correct two element names ShiftKey without updating schema version and date”.

MACHINEUSERID RESTRICTION AND EMPTY ELEMENT

Henrik Persson, Logmax, 2022-11-25

Mandatory element MachineUserID has the following definition:

*Machine identity set by user of data. Normally to be used and decided by logging organisation in order to identify a certain machine. For example necessary when paying forest on based on machine measurement. Registered in machine. 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, %, ?, !, \$, %, ", ' (double quote), /, \, |, *.*

It has previously been possible to leave the element MachineUserID empty in some controllers. It has been noted by Henrik Persson that this is not possible anymore in 4.0 due to the new data type UserIDType which has a restriction forbidding empty elements.

Presently no modification or update suggested.

GENERAL EXPERIENCES FROM WORK ON 4.0 SCHEMAS

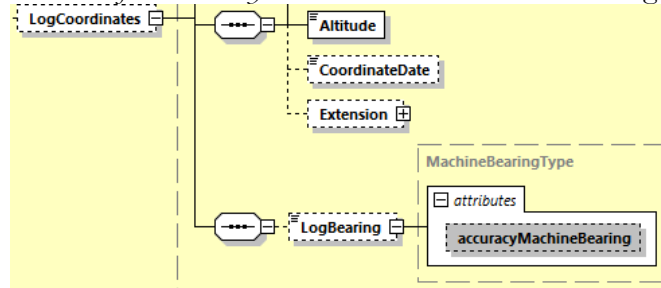
Fredrik Tjernberg, Komatsu, raised a couple of new issues. It was decided to discuss these issues at the next meeting:

- Attribute qualityIndicatorGNSSType should perhaps be updated in order to also handle combinations of “PPS” and “RTK Fix”/”RTK Float”. This

would mean two new enumerations: "PPS RTK Fix" and "PPS RTK Float".

- Element LogBearing is of the type MachineBearingType. This means that the attribute of the element has the name "accuracyMachineBearing". A better attribute name would have been accuracyBearing.

Comment from secretary: The attribute name cannot be changed until version 5.0.



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

Comment from secretary: Changing the data type from nonNegativeInteger to nonNegativeDeciaml could be done with version 4.1.

§6 Proposals for next version 4.1

STEMCODE UPDATES

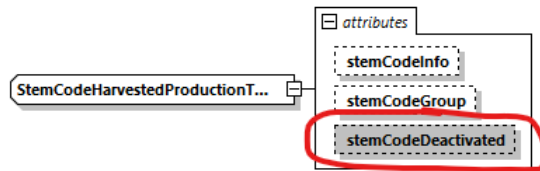
Andreas Barth, Cgi, 2023-01-27

Quite often the number of stem codes used on a specific market (e.g. Sweden and Finland) is extensive in order to satisfy geographically varying demands. It would be an advantage to continue working with a basic default spi including all possible stem codes in order to avoid regional dialects.

The present list of codes included in the Swedish default spi-file is:

StemCode (Swedish)	"stemCodeGroup"	Description
Högstubbe	Nature	High stump for bio diversity
Kulturstubbe	Culture	High stump for cultural objects
Evighetsträd	Nature	Retention tree
Trädgrupp	Nature	Group of trees
Plockhuggning	Special harvesting	Selective cut
Grovtopp	Nature	Large sized tree top
Överfart	Other	Bridge of creek
Vindfälle	Special harvesting	Wind throw
Insektsskada	Special harvesting	Insects damage
Toppbrott	Special harvesting	Top breakage
Brandskada	Special harvesting	Fire damage
Katning	Nature	Debarked tree

It was therefore suggested that we add a new attribute in version 4.1 where it is indicated whether a StemCode is to be active in the UI of the machine or not. Attribute “stemCodeDeactivated” should be an optional Boolean.



With the following description:

Name	Type	Unit	Description
stemCode-Deactivated	boolean	true/false	Indicates if stem code is to be presented in user interface of harvester or not. Not shown in harvester in case value is true. Stem codes shown if attribute is missing.

Johan Möller commented that we will probably see additional needs for registering more geographical information when we have more accurate positioning of a harvester head or a forwarder grapple. One example could be registering poorly positioned “boundary stones” marking the boundary of a property.

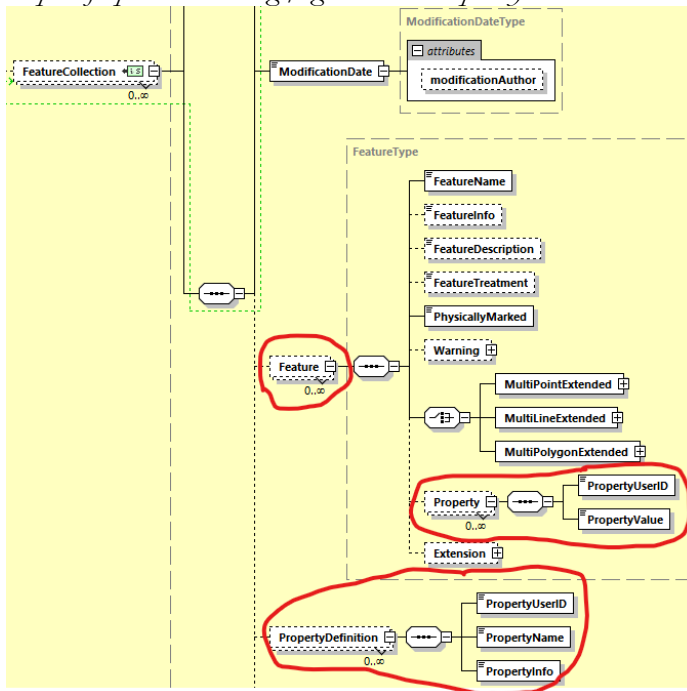
A couple of conclusions were drawn after a long discussion:

- Study the possibility of added “points of interest” or “features of interest” in the hpr. An alternative is to look at how the ogr could be used for the same purpose.
- Analyze the possibility of enclosing stem codes in the oin-file (also other object instructions) as a primary source rather than the spi-files.

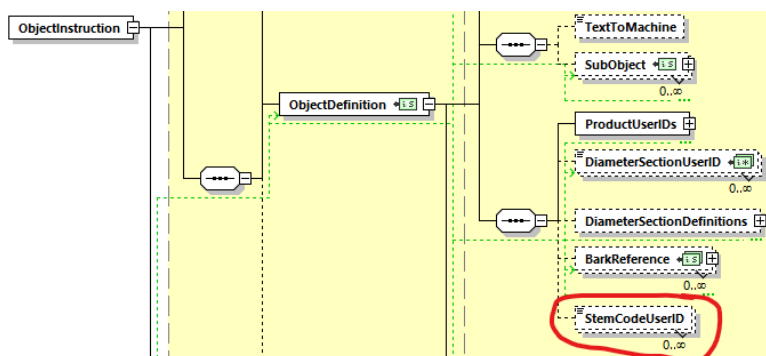
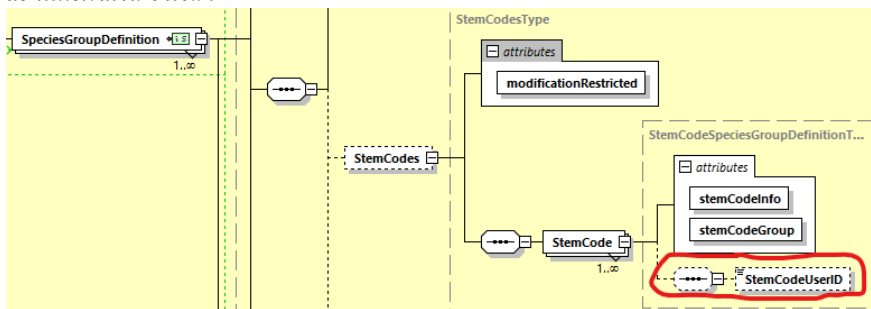
Comments from secretary added after the meeting:

With some modifications to ogi 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. The hpr-file is in most cases used for “partial” reporting where only new stems are reported. In cases of features added by the operator we will probably find situations where the operator deletes or modifies features previously reported. However, this probably needs a

couple of updates to the ogi/ogr schemas as partly described at last meeting and illustrated below.



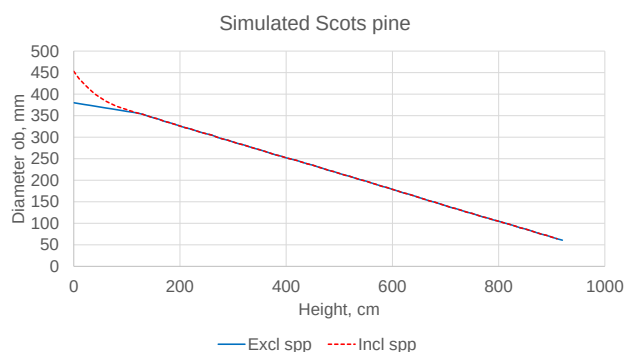
Controlling what StemCodes to use through the oin could be solved by adding a *StemCodeUserID* to the spi-file under element *StemCode* and then update the object definition in oin- and boi-files as illustrated below:



BUTTENDEXTRAPOLATION DESCRIPTIONS

Henrik Persson, Logmax, 2023-03-23.

Below is an old illustration of the butt-end extrapolation function (sometimes described as an spp-function) where the red line illustrates the fact that the function is used for extrapolating the diameter vector from a given position and downwards. This position is in most case at 130 cm from the stump (Finland/Sweden/Norway). The position is registered in element ReferenceHeight.



This is the original statistical function as specified by LUKE:

$$DL = [1 + (a0*(1.3-L) + a1*(1.3-L)a2)/100] * D1.3$$

where

DL = diameter at the distance L from the felling cut point, cm

L = distance from the felling cut point, m

$D1.3$ = measured diameter at the height of 1,3 m (reference height) from the felling cut point, cm

Models for butt end profile parameters:

$$a0 = a00 + a01*D1.3 + a02*D1.3^2 + a03*D1.3^3 + a04*D1.3^4$$

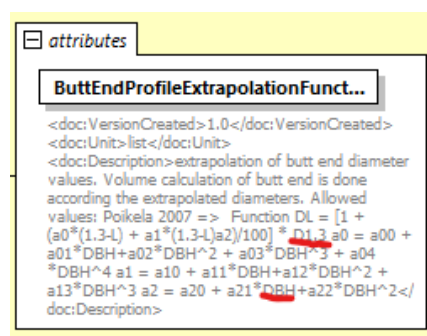
$$a1 = a10 + a11*D1.3 + a12*D1.3^2 + a13*D1.3^3$$

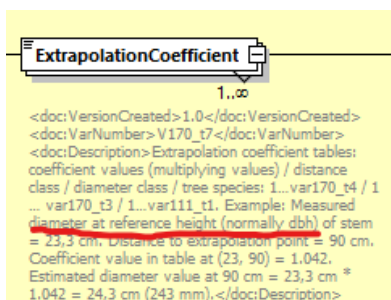
$$a2 = a20 + a21*D1.3 + a22*D1.3^2$$

where

$$D1.3 = \min(45; D1.3)$$

It has been noted by Henrik Persson that the descriptions for ButtEndExtrapolation elements are somewhat confusing as the terms “D1.3”, “DBH” and “diameter at reference height” are all used for the same diameter. The figures below illustrate the fact that the first measured diameter used in the butt-end extrapolation function is not consistently described:



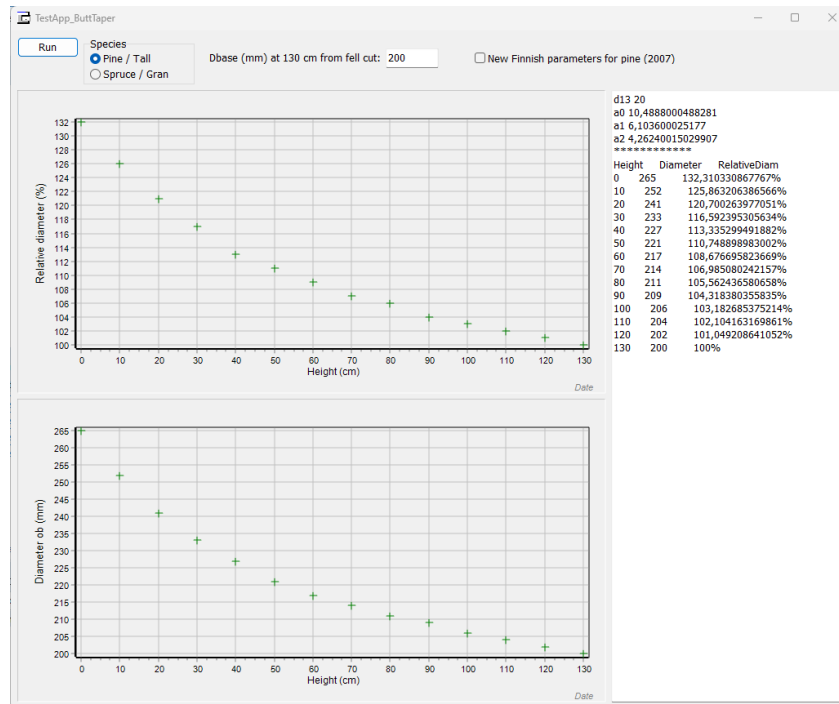


It was decided by the meeting that the term “base diameter for extrapolation” and abbreviation D_{base} is used according to the following table with version 4.1:

Name	Present description	New description
ButtEndProfile-Extrapolation	Structure for butt end profile extrapolation method. Extrapolation method must be used if this structure is included in spi. Extrapolation method must be used also in cases where you get measurement values below breast height (normally 130 cm).	Structure for butt end profile extrapolation method. Extrapolation method must be used if this structure is included in spi. Extrapolation method is used even if machine generates measurement values below ReferenceHeight (normally 130 cm). Volume calculation of butt end is done according to the extrapolated diameters.
ReferenceHeight	Height from stump to the diameter used for predicting the butt end diameters. Normally breast height (130 cm in Finland, 120 cm in Sweden) is used for extrapolation of butt end diameter values.	Height from fell cut point (H_r) to the position of the base diameter used for predicting the butt end diameters . Abbreviation D_{base} used for measured diameter at this position . Normally at 130 cm but it is possible to develop extrapolation functions based on other height positions.
Extrapolation-Coefficient	Extrapolation coefficient tables: coefficient values (multiplying values) / distance class / diameter class / tree species: 1...var170_t4 / 1 ... var170_t3 / 1...var111_t1. Example: Measured diameter at reference height (normally dbh) of stem = 23,3 cm. Distance to extrapolation point = 90 cm. Coefficient value in table at (23, 90) = 1.042. Estimated diameter value at 90 cm = 23,3 cm * 1.042 = 24,3 cm (243 mm).	Extrapolation coefficient tables with coefficient values per distance class and base diameter class (D_{base}) . Example: Measured diameter at reference height (D_{base}) of stem = 23.3 cm. Distance to extrapolation point = 90 cm. Coefficient value in table at (23, 90) = 1.042. Estimated diameter value at 90 cm = 23.3 cm * 1.042 = 24.3 cm (243 mm).
diameterClass	Diameter class values for the reference height in extrapolation coefficient table / species group.	Base diameter class values for the reference height in extrapolation coefficient table.
ButtEndProfile-Extrapolation-FunctionCategory	extrapolation of butt end diameter values. Volume calculation of butt end is done according to the extrapolated diameters. Allowed values: Poikela 2007 => Function DL = $[1 + (a0*(1.3-L) + a1*(1.3-L)^2)/100] * D_{1.3}$ $a0 = a00 + a01*DBH + a02*DBH^2 + a03*DBH^3 + a04*DBH^4$ $a1 = a10 + a11*DBH + a12*DBH^2 + a13*DBH^3$ $a2 = a20 + a21*DBH + a22*DBH^2$	Type of function for extrapolation of butt end diameter values. Allowed value: Poikela 2007 => Function DL = $[1 + (a0*(H_r - L) + a1*(H_r - L)^2)/100] * D_{base}$ $a0 = a00 + a01*D_{base} + a02*D_{base}^2 + a03*D_{base}^3 + a04*D_{base}^4$ $a1 = a10 + a11*D_{base} + a12*D_{base}^2 + a13*D_{base}^3$ $a2 = a20 + a21*D_{base} + a22*D_{base}^2$ where DL = diameter at the distance L from the felling cut point, cm L = distance from the felling cut point, m D_{base} = measured diameter at the reference height H_r = reference height from the felling cut point, cm Note that function Poikela 2007 was developed for H_r being 1.3 m (element ReferenceHeight with value 130 cm). H_r must

be 1.3 m in case of using parameters according to Finnish regulations.

Some test applications for this functions has been developed by the secretary (e.g. TestApp_ButtTaper.exe). Do not hesitate to contact the secretary if there is a need for testing of these softwares.



REVERSE TOP SAWING

Heikki Kumulainen, Ponsse 2022-10-24

Valuable hardwood trees often have double stems, forks or very thick branches that cannot be properly delimbed by a harvester.

In order to cut a valuable log all the way up to the branch a top saw could be used. However, most harvesters are not equipped with top saws which means that a shorter, less valuable, log must be cut. A solution could be to measure the log all the way up to the branch using the upper knives and thereafter open the head and then turn the head around in order to cut the log as close as possible to the branch. However, the measurement accuracy of the log length will certainly be lower, it is therefore deemed necessary to register that this procedure (reverse top sawing) has been used.

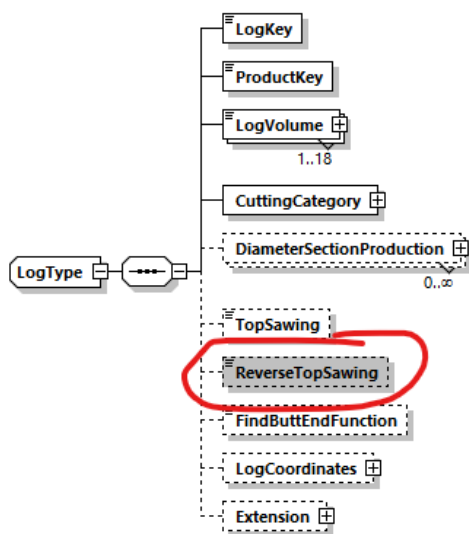
The procedure can be illustrated by the following three steps:

1. measure the log up to the branch and
2. open the head and turn it around
3. cut the log as close as possible to the branch.



It was therefore suggested at the previous meeting that we add a new optional element ReverseTopSawing:

Name	Type	Unit	Description
ReverseTopSawing	boolean	true/false	Indicates if the log has been measured when feeding all the way up to an obstacle (typically a thick branch) using the upper knives and thereafter open the head and then turn the head around in order to cut the log as close as possible to the obstacle (branch) using the saw.

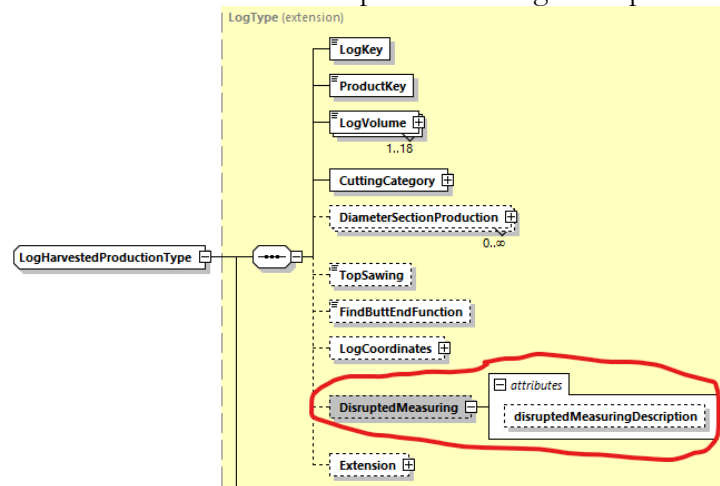


The previous meeting discussed the possible needs to handle other functionalities that makes it possible to process “feeding obstacles”. An example is the possibility to open the knives partially to feed a sharp bend or fork without releasing the stem from the head.

It was decided at the previous meeting to let the secretary study this issue further.

As the objective of the proposal was to indicate that the measuring precision may be lower it was decided to include a more general element DisruptedMeasuring in version 4.1 (LogType). The new element can be used for any type of disruptions that decreases the measuring accuracy in a significant way. Typically, the value is “true” if length measuring wheel is not in constant contact with the stem. It is also possible to add an optional attribute where a manufacturer specific descriptive

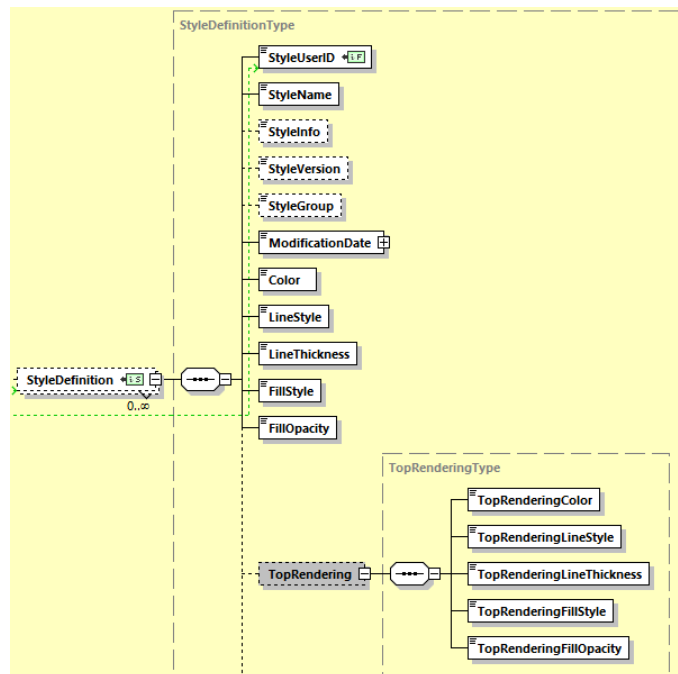
text can be included in disruptedProcessingDescription.



Name	Type	Unit	Description
Disrupted-Measuring	boolean	true/false	Disruptions in measuring of log that decreases the measuring accuracy in a significant way. Typically, value is true if length measuring wheel is not in constant contact with the stem. An example is if the head is completely opened during feeding of log due to significant defect such as stem fork.
disrupted-Measuring-Description	String	Free text	Text describing reason for disrupted measuring. Free text set by the harvester controller.

TOPRENDERING REPEATABLE

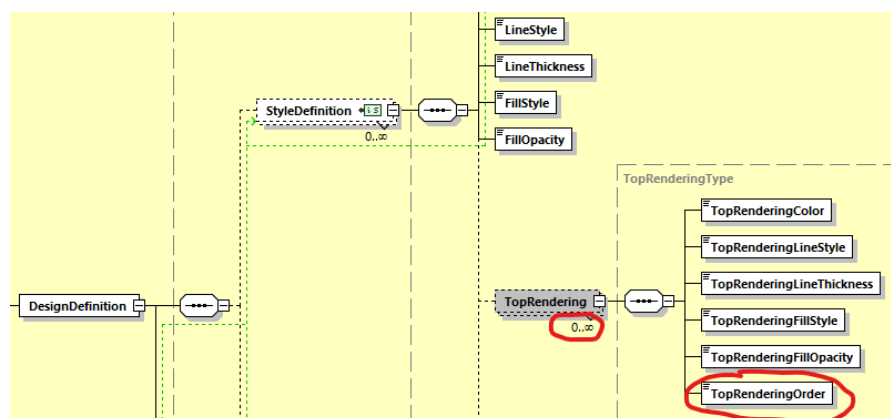
TopRendering is presently not repeatable in version 4.0 of ogi- and ogr-schemas:



Making TopRendering repeatable would make it possible to have more complex styles for different features. However, it is needed to also add an attribute for RenderingOrder in order to make it a useful update.

It was decided at last meeting to let the secretary update the proposal for the next meeting.

It was therefore decided to add a new element TopRenderingOrder and to make TopRendering repeatable in version 4.1.



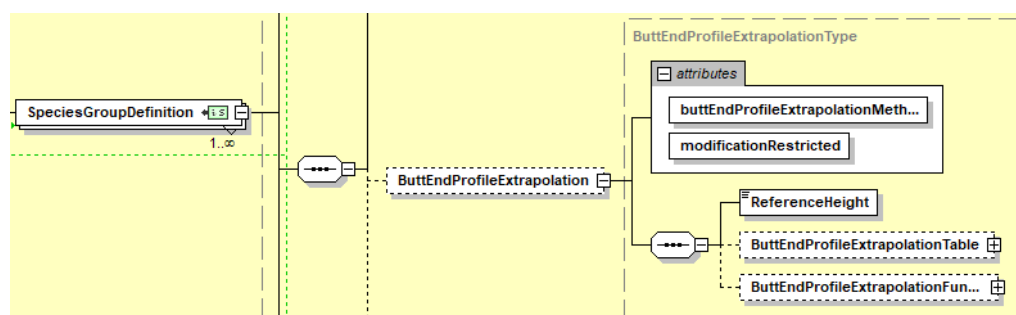
Name	Type	Unit	Description
TopRendering-Order	Positive integer	no	Order of presentation for rendering additional styles (e.g. colors) on top of the basic style definition. For example, 1 is the topmost layer

NEW RULE FOR REFERENCEHEIGHT IN FINLAND

Antti Uurtamo, Masser Oy, proposed at the previous meeting that we should have a StanForD Rule which specifies that ReferenceHeight in spi (SpeciesGroupDefinition.ButtEndProfileExtrapolation.ReferenceHeight) must always be 130 cm in Finland.

It was decided to let the secretary investigate this issue further.

A question regarding ReferenceHeight was been sent out to all members. No controller today has a UI for modifying the ReferenceHeight or any other ButtEndExtrapolation parameters. It was observed that modificationRestricted exists as a safe guard against any tampering with ReferenceHeight in the machine.



It was therefore decided to not add a new rule regarding ReferenceHeight.

Observe that it must be possible to take a “new” ButtEndExtrapolation function in use on markets where the bucking instruction is constructed in the harvester. However, it is recommended the parameters are not to be modified in the

machine meaning that they are either constructed by a manufacturer or a forest company outside the machine.

SCARIFICATION AND PLANTING

A draft for a suggested new standard for reporting data on forest regeneration (scarification or planting) was presented by the secretary as described in appendix 1. No objections were raised regarding the idea of including this new type of message.

So far this proposal has been discussed with Bracke Forest and ForestLink. The plan is to arrange meetings also with Risutec, Plantma, M-Planter and Södra skogsägarna. The objective is to have a finalized proposal for the next StanForD version (4.1).

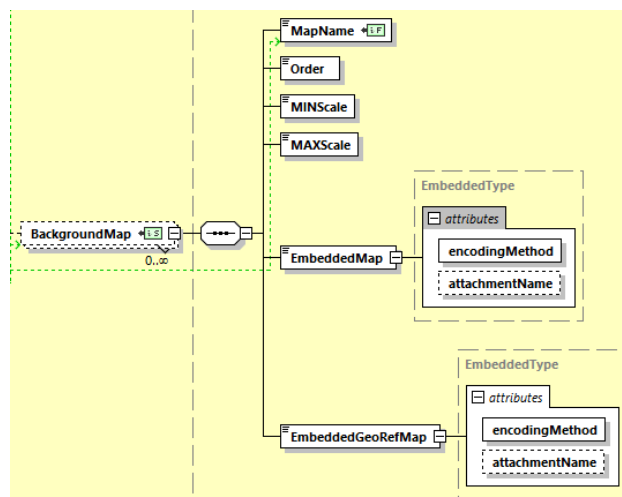
There were a few comments raised at the meeting. It was decided to let the secretary analyze the following issues until the next meeting:

- Make certain that it is possible to include information about the use of fertilizers, water, herbicides and insecticides when planting.
- Additional information about provenance (origin of seedling), often described on the cardboard boxes used for transporting the seedling.
- Analyze the possibility of merging seedling and scarification structures. Perhaps using a new structure called TreatmentCoordinates.

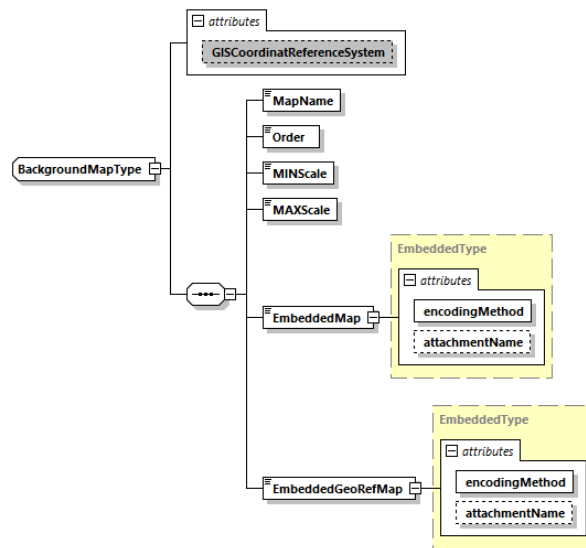
§7 Items for discussion

EMBEDDEDGEOREFMAP NOT RELEVANT

The positioning of a background map (e.g. jpg, tif) is given by a world file (e.g. jgw, tfw) that is enclosed in element EmbeddedGeoRefMap. However, these files normally does not include information about what geo-reference system is used.



It was therefore decided that we add a mandatory GISCoordRefSystem attribute also to the background maps (element BackgroundMap) in version 4.1. as illustrated below:



In order to handle this issue when testing ogi 4.0 the secretary added an extension to the ObjectDefinition as illustrated below:

<> ObjectDefinition	
<> ObjectUserID	s43f
<> ObjectName	Väsby 2018
<> ObjectModificationDate	2022-06-28T12:00:00.000+00:00
<> ForestCertification	Not known
<> Extension <> BackGroundMap GISCoordinateReferenceSystem EPSG:3006	
<> SubObject <SubObjectUserID> 24325432 <SubObjectName> Delskogen	
<> FeatureCollection (5)	
<> BackgroundMap (3)	
<> InformationToOperator	

Henrik Persson pointed out a problem with the present 4.0 structure since it requires that a world-file must be included in element EmbeddedGeoRefMap. This is a problem since there exists bitmap-files that include georeferences. This means that the EmbeddedGeoRefMap is not always needed. A rule must be defined for handling this situation. There are three different alternatives:

1. Enclose the same file in both EmbeddedMap and EmbeddedGeoRefMap. This means complete redundancy.

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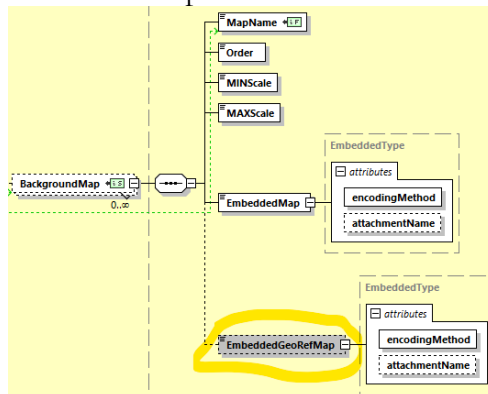
<BackgroundMap>
  <MapName>Aerial photo</MapName>
  <Order>1</Order>
  <MINScale>1</MINScale>
  <MAXScale>50000</MAXScale>
  <EmbeddedMap encodingMethod="Base64" attachmentName="010rtofoto3.bmp">
    /9j/4AAQSkZJRgABAgAAQABAAD/2...qqW5u4f4RHI+kbfftQT//2Q==String</EmbeddedMap>
  <EmbeddedGeoRefMap encodingMethod="Base64" attachmentName="010rtofoto3.bmp">
    /9j/4AAQSkZJRgABAgAAQABAAD/2...qqW5u4f4RHI+kbfftQT//2Q==String
  </EmbeddedGeoRefMap>
</BackgroundMap>

```

2. Include an empty element EmbeddedGeoRefMap with only the attribute "EncodingMethod" containing any data.

```
<BackgroundMap>
  <MapName>Aerial photo</MapName>
  <Order>1</Order>
  <MINScale>1</MINScale>
  <MAXScale>50000</MAXScale>
  <EmbeddedMap encodingMethod="Base64" attachmentName="010rtofoto3.jpg">
    /9j/4AAQSkZJ...qxd+fccIIqqW5u4f4RHI+kbfftQT//2Q==String
  </EmbeddedMap>
  <EmbeddedGeoRefMap encodingMethod="Base64"/>
</BackgroundMap>
```

3. Make element EmbeddedGeoRefMap optional, means that only EmbeddedMap is used if the coordinates are included inside the map.



The meeting decided postpone this issue to the next meeting. Most participants preferred alternative 3 with version 4.1.

STEMCODE IMPLEMENTATIONS

John Arlinger, 2023-01-26

StemCodes are used by more and more harvesters on the Swedish market. The main reason is to register bio-diversity related parameters required in different certification systems such as FSC and PEFC.

Lately some issues have been raised by forest companies and harvester operators that relates to the use of stem codes. The following issues should be considered when implementing stem codes:

- No controllers today have any limitation on the total number of StemCodes included in the spi-file. However, the complexity of using the codes normally increases today with an increasing number of stem codes.
- Different companies and different operators prefer different presentation orders in the UI of the controller. It is therefore suggested to make it simple for the operators to move StemCodes upwards or downwards in order to have the most commonly used codes at the top.
- It is also suggested that the any ordering change is kept permanently in order to avoid having to update the presentation order when e.g. starting a new site.

- It is deemed relevant to have the possibility to register stem-codes also for felled and multi-tree-processed stems. There are situations in Sweden where a tree is only felled to the ground and left there for improved bio-diversity (“large sized tree top” in table above).

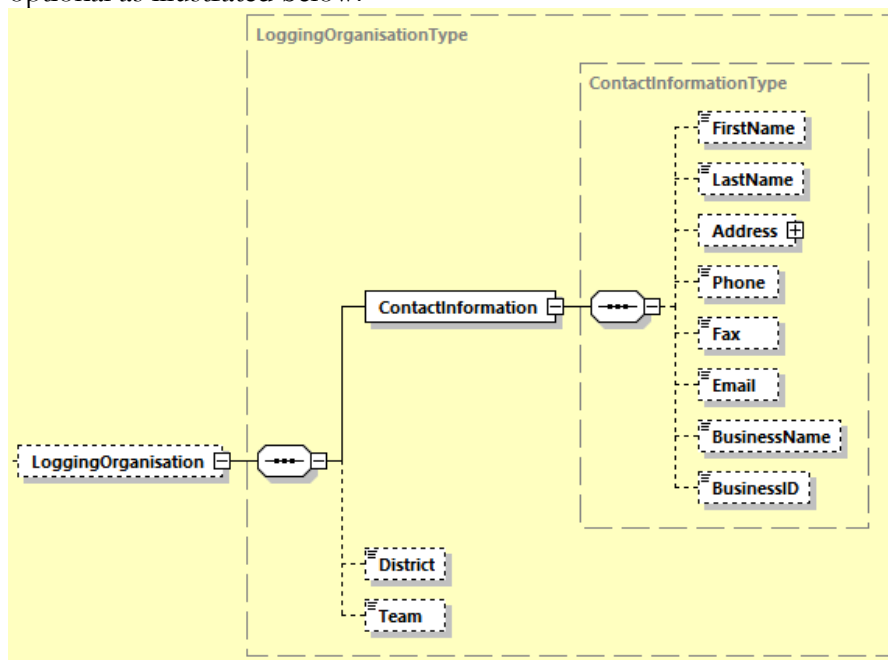
EMPTY ELEMENTS IN LOGGINGORGANIZATION

A problem with empty elements in LoggingOrganization have been noted in one control system lately where a proprietary validation will abort parsing of such a file. This is an example of a LoggingOrganisation structure that causes parsing to be aborted:

```
<ProductClass>sdf</ProductClass>
<LoggingOrganisation>
  <ContactInformation/>
</LoggingOrganisation>
<ProductDestination/>
```

There are two different conflicting standard issues in play.

1. ContactInformation was made mandatory while all child elements are optional as illustrated below:



2. There is a design rule (12.4) that states that “empty elements SHOULD NOT be used in StanForD 2010 messages”.

This means that there is a conflict between the schema and the design rule since the schema in some cases makes it impossible to generate a LoggingOrganisation structure without having empty elements. This typically occurs when all elements

under LoggingOrganisation are empty as illustrated below:

The simplest solution, which was recommended at the meeting, is that users of e.g. Silvia and ForesterOffice are always reminded to fill in at least a company name in the settings:

A final comment is to point out the importance of communicating new *internal validation rules* before implementation.

SHORT LOGS AND DIAMETER CONTROL MEASUREMENTS.

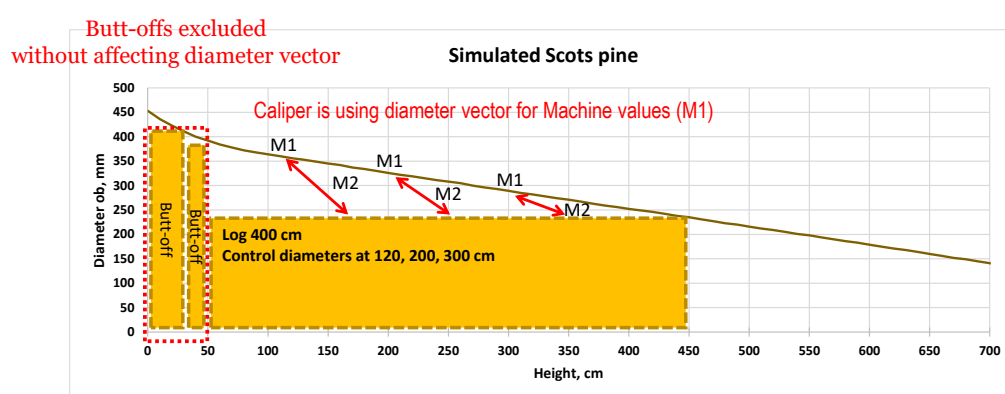
A similar issue was discussed in 2014-11-20 with a focus on when a stem is to be considered to be processed vs felled. The general conclusion was that at least one classified log must be possible to cut in order to consider the stem as processed and not felled. Short logs were also discussed in conjunction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

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

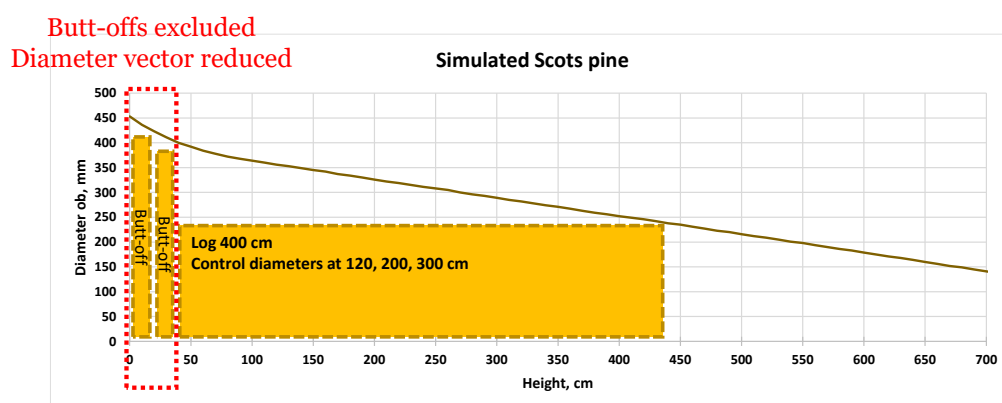
Same values as used in bucking optimisation and calculations of solid volumes. No systematic error when comparing log volumes and volume calculations based on DiamValue.

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):

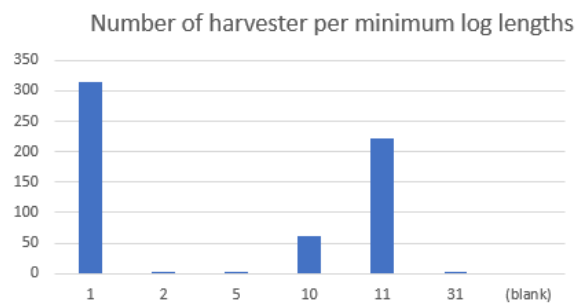
No systematic error when comparing log volumes and volume calculations based on DiamValue.

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 market demands.

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.



The main conclusions from the meeting discussion were that it would be relevant to have the secretary send out a questionnaire including the following questions:

- Is the diameter vector reduced 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?
- Is the length of butt-offs settable in the machine? What are the maximum and minimum lengths? Default value for maximum length? Different default settings on different markets?
- Is excluding very short logs affecting only the fell cut or also further up the stem?
- 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 all logs shorter than 30 cm are to be excluded?
- Should we add a new element “LogEndPosition” and “MINRegistrationLength” to the hpr as these would make it possible to identify stems where short logs have been discarded?

NEW TOOL: “STANFORD_HPRVERIFIER”

Bucking optimization and reporting of resulting data is complex. A tool for automatic evaluation of production data from a harvester could be a useful for both manufacturers and data users.

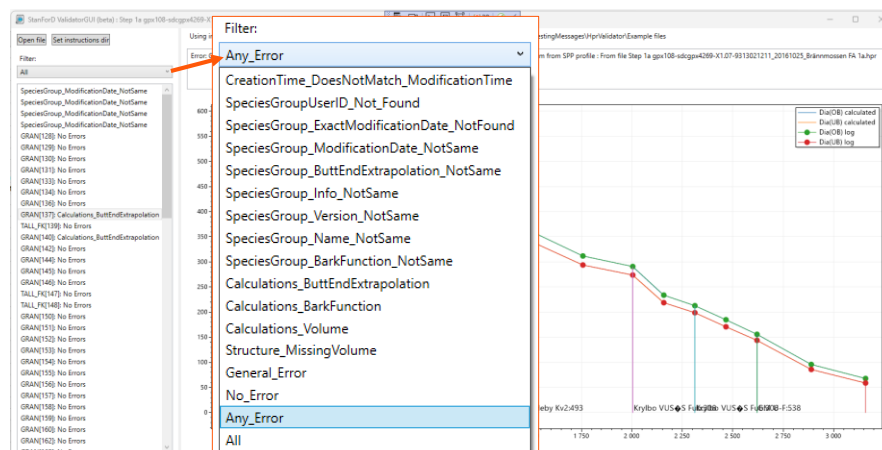
Fredrik Tjernberg at Komatsu initiated a discussion with Skogforsk regarding the development of a new software tool (StanForD_HprVerifier) for controlling StanForD-data with a focus on hpr. For example including:

- Controll calculations of log volumes based on diameter vector
- Comparison of ProductDefinition in hpr vs pin
- Checking hpr vs “rules document”
- Overlapping cutting windows
- Bark parameters using e.g. new consolidated function
- Testing pin files from 3rd parties

Some basic requirements:

- A control/settings document defines what controls to make.
- Diameter vector with a diameter per cm should be possible to use.
- Coding should be using C# or Java and be handled as “open source code”. The tool should not have any advanced user interface but just be returning som type of log file.
- Could also be available as a REST API

Fredrik Tjernberg, Komatsu, has developed a first version of “StanForD Verifier” using C# as an illustration of how this type of application could function. Fredrik has also done a simple interface even though the basic application should be possible to run without an interface (that is as a dll).



TRIMBLE FORESTRY PRESENTATION CF HARVEST (WOOD FORCE)

Juha Käppi, Trimble presented their CF Harvest system.

Juha Käppi (Trimble Forestry) presented Trimble's forest harvesting management system Connected Forest™ Harvest (marketed as WoodForce in Finland). He presented the principles of the solution focusing in how harvesting operations are planned, instructed and followed both in forest companies and machines. He also demonstrated how harvester and forwarder data are managed in the system. Some comments:

CF is an abbreviation for Connected Forestry.

Controllers with WindowsXP are not supported anymore. An Android app exists as an alternative.

CF Harvest consists of both a module for planning and scheduling that can be used by either contractors or forest companies and another module (CF Harvest Mobile) for the forest machines.

Forest company systems only use StanForD for communicating pin-files to CF Harvest. All other information is based on the Finnish standard for forest data. This format includes all information needed for creating an oin.

Communication between CF Harvest and the harvester controller is based on StanForD2010. CF Harvest has the ability to transmit all types of StanForD files back to the forest company system (hpr/hqc/fpr/mom).

Trimble is planning to start supporting not only cumulative hpr-files from the harvester but also "partial reporting" from autumn 2023. This new update will also support automatic generation of hpr and it will extract not only the mass but also volumes from the fpr.

CALIBRATION LOGS IN HQC, COILLTE NEEDS

Mike O'Shea, Coillte, presented how they are working on how to improve harvester measuring. Coillte is the Irish state forest company. The harvest around 2.7 million m3 annually. Presently most of the logging is done by contractors but Coillte owns one harvester and two forwarders.

Coillte started using StanForD in 2004. They are today using the following StanForD messages:

- Instruction Files: APT and FOI files
- Production Files: PRI, FPR and some HPR files
- Control Checks: KTR files

The focus has always been on Value Bucking Optimisation. Currently they are working on improving harvester head measurements on length & diameter.

Short term improvements regarding harvester measuring:

- Ensure sample/audit of Control Checks are observed by foresters on work sites

- Complete Training on Control Check procedures in each region
- Complete training of machine operators on technique and procedures
- Implement recommendations of the “Measure Up” Skogforst Report

Medium term improvements regarding harvester measuring:

- Control check on one tree once per day
- Ensure all Control Checks are sent to Coillte database daily

Long term improvements regarding harvester measuring:

- Implement an auditing function of the harvester head and machine operator (M3)
- Move to Certified Quality Harvester based on 2 checks per year
- Implement third party certification of the Harvester Head measurements

SUSTAINABILITY - HVO PILOT TESTS AT COILLTE

Mike O'Shea, Coillte, presented an on-going development programme where feasibility studies are conducted in order to determine the most sustainable and cost-effective alternatives to fossil-based fuels in forest operations. Coillte will run tests on using HVO fuels in forest machines.

CALIBRATION OF MULTITREEPROCESSING, SKOGFORSK

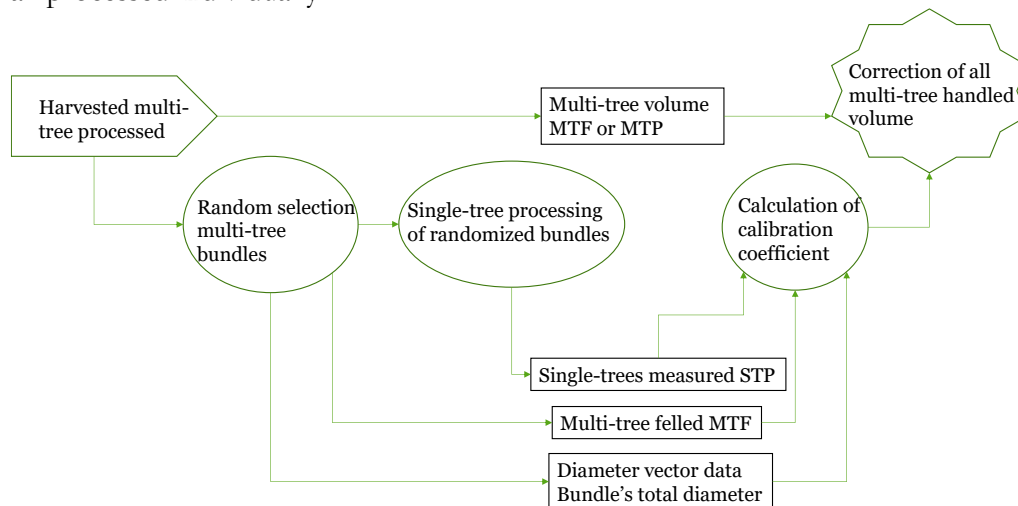
Martin Whillans, Skogforsk, presented work on developing and testing a new method for calibrating volume estimations during multi tree processing.

The driving factors for this work are:

- Harvester volume used as basis for payment, wood contract transactions. Increased efficiency in logistic chain for industry if volume basis for payment is determined in the field.
- Improved precision in prognosis for standing volume after harvest (e.g., hprThinning) used in stand registry update.
- Quality controlled harvester measuring (Biometria, Sweden) – currently lacks a routine for volume produced with any other method apart from single-tree processing.

Following diagram illustrates the suggested new method which is based on a random selection of multi-tree bundles where the individual stems in a bundle are

all processed individually.



Some first practical tests will be carried out together with Södra, Sveaskog, StoraEnso, JohnDeere and LogMax during the upcoming summer.

PREDICTION IF DIAMETER STANDARD DEVIATION BASED ON DIAMETER VECTOR.

Björn Hannrup, Skogforsk, presented a new model to estimate measurement precision for the harvester's diameter sensing.

The new model was developed with input data in the form of high resolution diameter vectors (hpr-file) and the output is an estimation of measurement precision (standard deviation). The model does not predict any systematic deviations.

Practical tests has been carried out together with Vida and Biometria where experiences has been accumulated. A prototype software was developed where a number of relevant key figures are calculated. The tests have helped us in identifying and documenting the benefits of the model.

Skogforsk is freely sharing the prototype software and the algorithms. The implementation process started (Biometria, other companies).

The work report describing the method can be downloaded her (only in Swedish):

<https://www.skogforsk.se/kunskap/kunskapsbanken/2020/nya-uppfoljningsverktyg-for-forbattrad-diametermatning-i-skordare/>

The prototype software is available here:

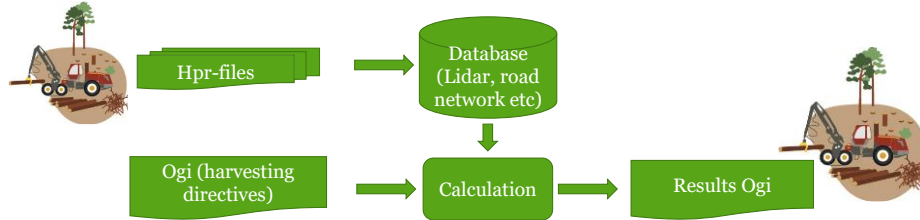
<http://download.skogforsk.se/SF-Program/hprStamhallning.zip>

OGI 4.0 PROJECTS IN SWEDEN

Skogforsk's work on developing algorithms and applications for monitoring of biodiversity considerations partly based hpr-data has continued. The project includes

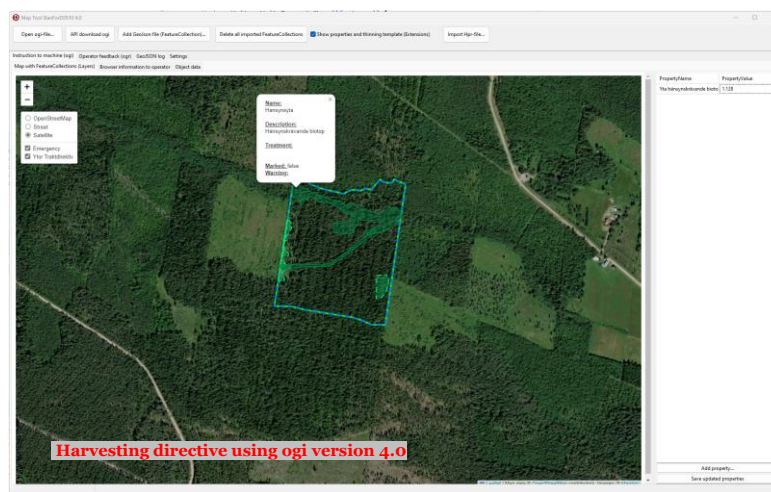
large number of Swedish companies. Some test cases with Mellanskog/ForestLink and Holmen/CGI are being developed.

The figure below illustrates the main information flows in the project:

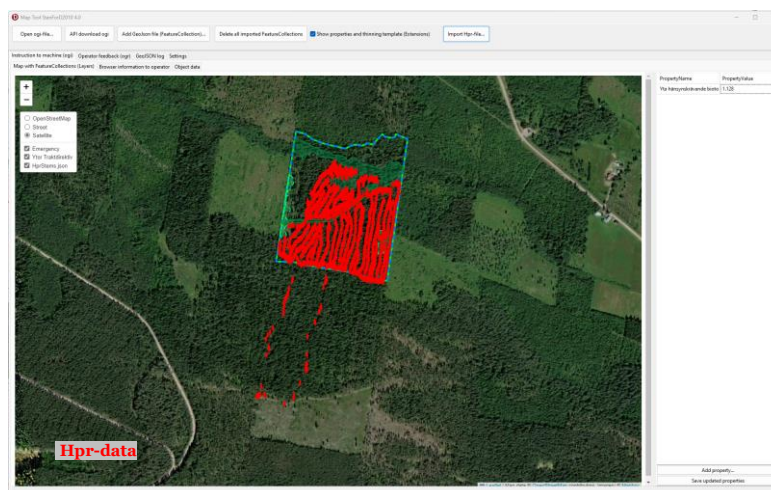


The ogi format is a very important building block. Below are some examples from the test case involving Mellanskog and ForestLink:

Harvesting directive from Mellanskog/ForestLink in ogi format:



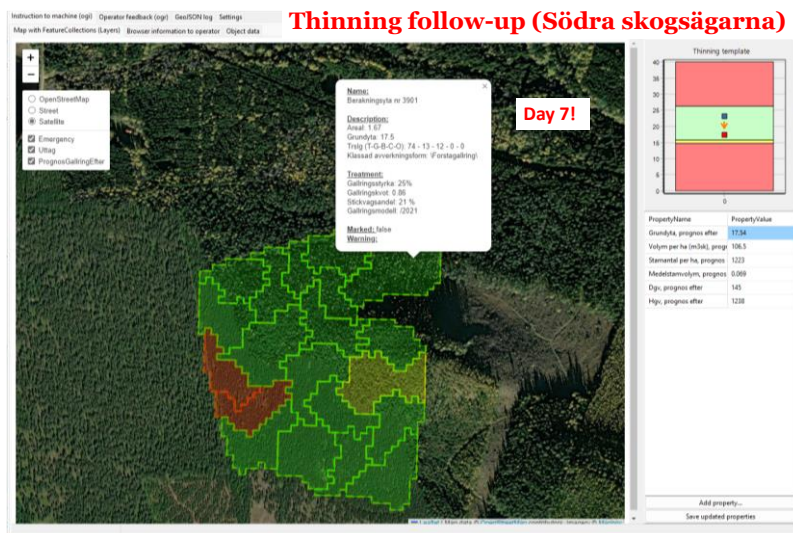
Harvested production from Mellanskog/ForestLink:



Bio-diversity key figures sent back to harvester using ogi:



More work has also been carried out on using *ogi* for reporting prognosis of thinning results as illustrated below:



“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 probably be carried out in the autumn of 2024.

§10 Other issues

No other issues

§9 Next meetings

StanForD meeting 2023-11-22—23, Uppsala/Växjö/Teams (12:00-15:00 CET)

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

2023-05-08

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 scarifiers 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 (Coiltte). 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.

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 standardized digital format.

The objective of this document is to describe how a standard for reporting scarification and planting production/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 scarifiers and planting machines.

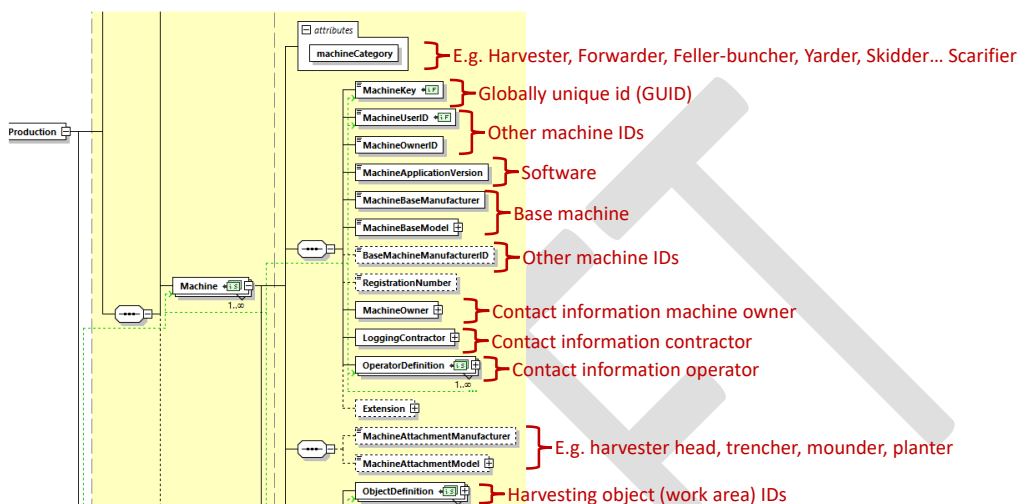


Figure 1. Illustration of generic MachineDefinition structure presently used in all StanForD schemas.

= 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
		Abc 34482857
<> 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 in for all possible machine types and message types.

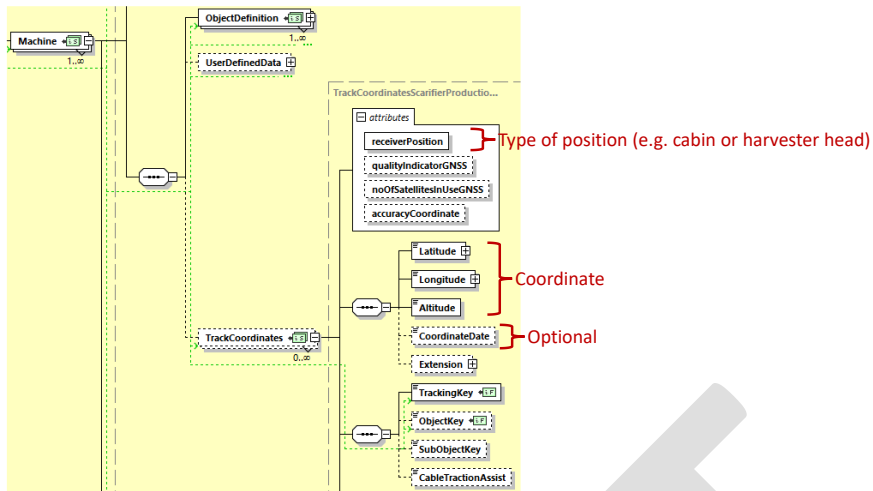


Figure 3. Schema structure for TrackCoordinates



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

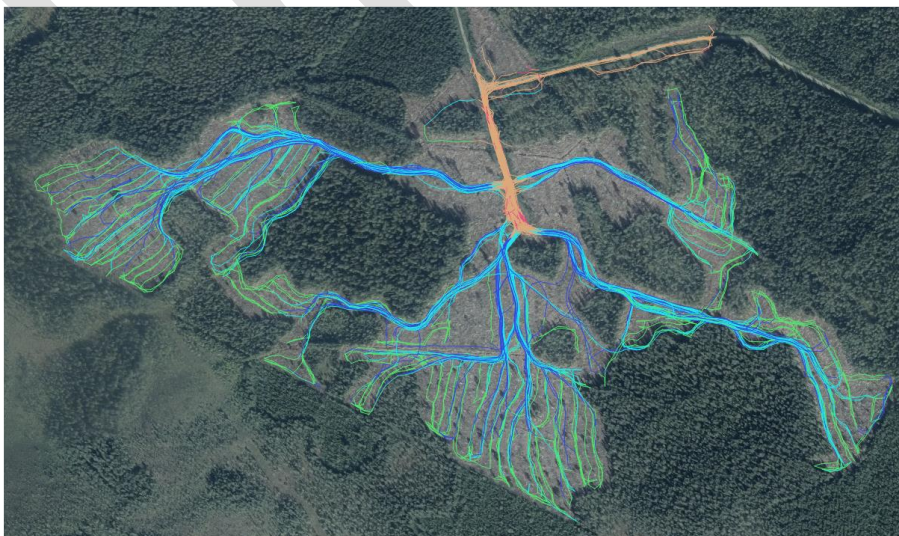


Figure 5. Tracking data extracted from forwarder fpr-file. Different colors dependent on speed of forwarder.

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 would be possible to extend this structure specifically for scarifiers and planting machines.

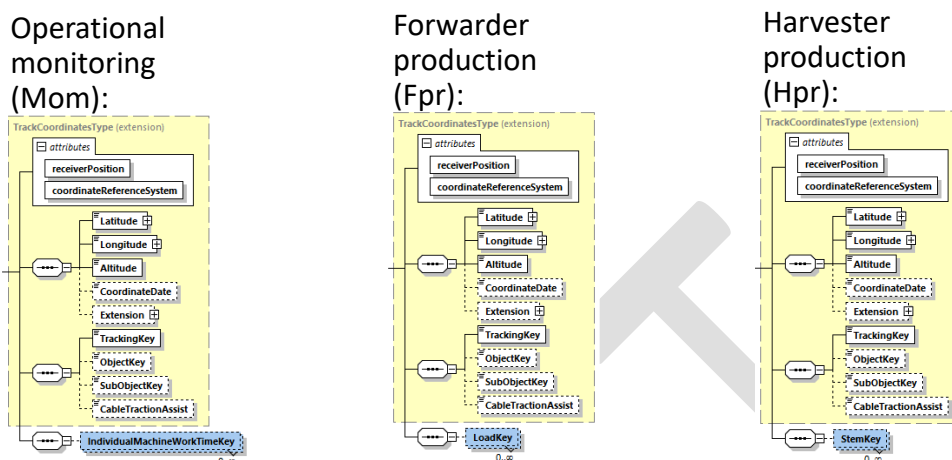


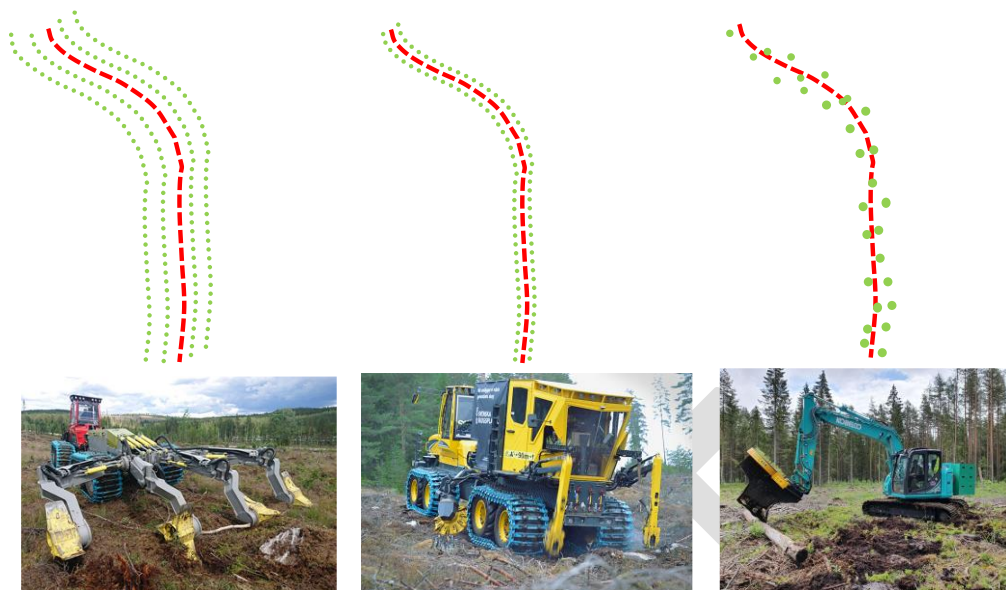
Figure 6. Illustration of the differences in how tracking can be used in different message (mom/hpr/fpr).

Draft proposal

DESIGN

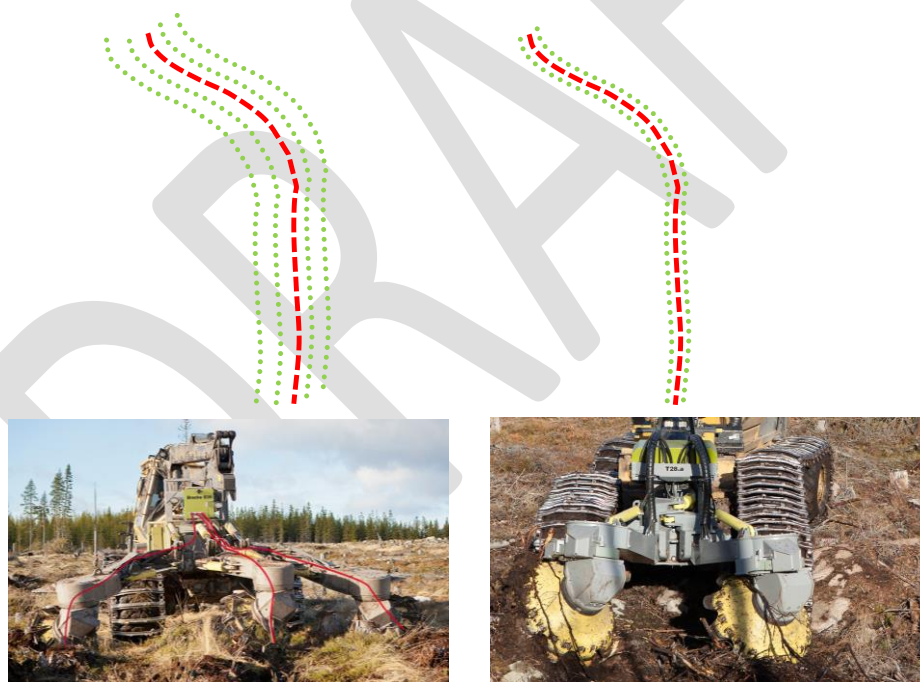
The basic idea is to re-use the MachineDefinition and TrackCoordinate structures for scarifiers and planting machines as tracking data is most probably a useful structure for “carrying” information regarding the work of a scarifier and/or planting machines. The basic idea is to make it possible to extract 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 scarified). The original idea was to create separate schemas for scarifiers and planting machines. However, as several different machine constructions can simultaneously carry out scarification 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 and intermittent both in the case of scarifiers and planting/sowing machines. Typically planting of seedlings is a could be view as 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 scarifiers could also carry out both coninuos and intermittent work. Typically 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 scarification and planting. The red line represents the movement of the machine (tracking) while the green points represent the positions (points) that have been scarified and/or planted.



Continues treatment (lines)

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



Continues treatment (line where machine is enough)

Figure 9. Basic data registered for scarification. 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).

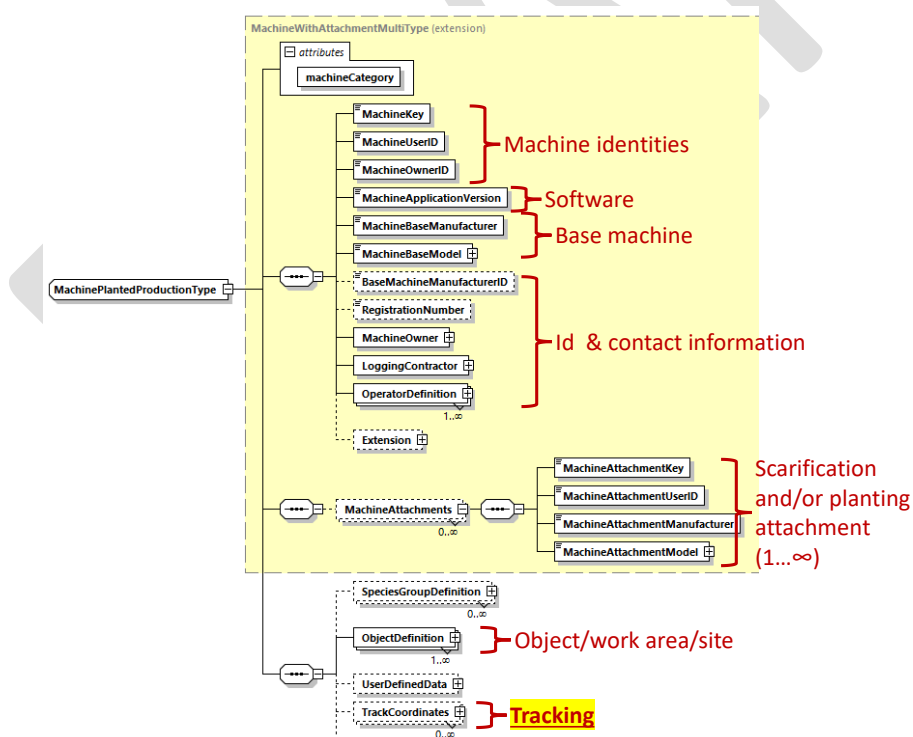


Figure 10. Basic structure for machine data where element MachineAttachment is repeatable since both scarifiers and planting machines may have several separate devices (e.g. a four row disc trencher) several separate MachineAttachments could be registered.

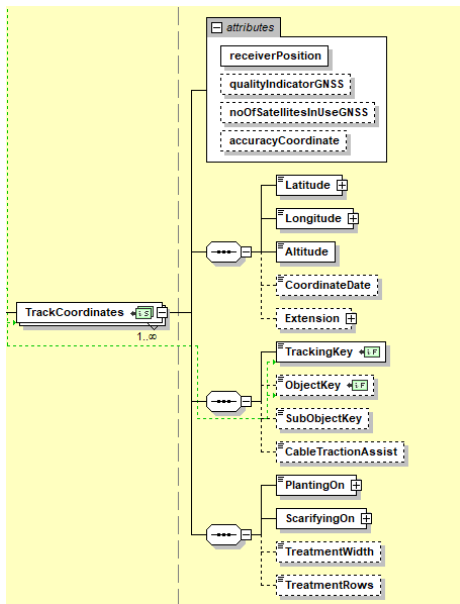


Figure 11. Tracking structure including both planting and scarifying data. Observe that planting/scarifyingCategory are both enumeration lists with values *Continuous* or *Intermittent*.

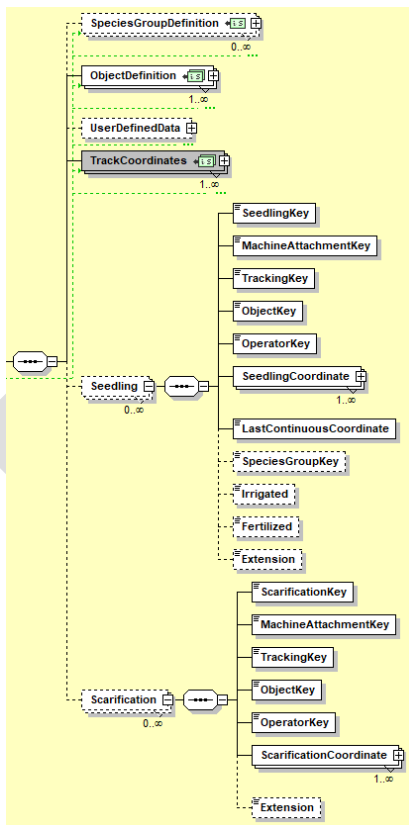


Figure 12. Detailed information describing the work of each individual attachment. This structure makes it possible to e.g. report data from a scarifier that is sowing only certain parts of an object (work area) while scarifying the whole object. Both Seeding and Scarification structures can be interpreted as a "line" or a "point" depending on type of equipment in use (see attributes plantingCategory and scarifyingCategory).

How to trigger coordinate registration

Reporting of planting and scarification 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 Scarification must have a reference to a specific tracking position. This means that there is always TrackingCoordinate corresponding to each Seedling or Scarification coordinate.

The following events should trigger registration of a tracking position:

1. More than 10 m since last tracking position
2. When there is a change in treatment/activity. A change in activity occurs when one or several attachments are turned on or off.
3. When an intermittent seedling or scarification position is created

Intermittent work

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

Continuous work

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

EXAMPLES

Two-row trencher

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



Table 1. Tracking example

Receiver-Position	Tracking-Key	Latitude	Longitude	Date	Planting-On	Scarifying-On	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. Scarification example

Scarification-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 scarification per attachment are to be viewed as large number of points.



Table 3. Tracking example

Receiver-Position	Tracking-Key	Latitude	Longitude	Date	Planting-On	Scarifying-On	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	True	True		
Base machine	3...5				True	True		
Base machine	6	60.4430663	17.2759374	2022-09-07 T14:11:12.14	True	True		
Base machine	7	60.442985	17.2758838	2022-09-07 T14:53:08.25	False	False		
Base machine	8	60.4429898	17.2757086	2022-09-07 T15:02:33.63	False	False		
Base machine	9	60.4429413	17.2755655	2022-09-07 T15:05:38.66	False	False		

Table 4. Scarification example

Scarification-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 moulder

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



Table 6. Tracking example

Receiver-Position	Tracking-Key	Latitude	Longitude	Date	Planting-On	Scarifying-On	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	True	True	250 cm	2
Base machine	3...5	...	...	...	True	True	250 cm	2
Base machine	6	60.4430663	17.2759374	2022-09-07 T14:11:12.14	True	True	125 cm	1
Base machine	7	60.442985	17.2758838	2022-09-07 T14:53:08.25	True	True	250 cm	2
Base machine	8	60.4429898	17.2757086	2022-09-07 T15:02:33.63	False	False		
Base machine	9	60.4429413	17.2755655	2022-09-07 T15:05:38.66	False	False		

Table 7. Scarification example

Scarification-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

Scarification-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

Receiver-Position	Tracking-Key	Latitud	Longitude	Date	Planting-On	Scarifying-On	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	