StanForD 2010

– modern communication with forest machines


Photo: Komatsu

Innehåll

Summary

StanForD 2010 is the forestry sector's standard for manage- ment of data to and from forest machines. The standard is global and is used by all major manufacturers of forest machines applying the cut-to-length (CTL) method. StanForD 2010 is the updated version of the StanForD standard that has been available since the end of the 1980s. The biggest differences between StanForD 2010 and the earlier version are as follows:

- StanForD 2010 introduces a concept for giving **identities** for machines, objects, stems, logs, etc. with Keys and UserIds. A Key is set automatically in the machine (usually a consecutive number) and a UserId is allocated by, for example, the logging organisation. The system makes it theoretically possible to isolate each log and stem that is produced globally and provides trace- ability for each modification of the settings in the machine.
- The nnew system of identities also permits **flexible control** in logging operations, i.e. changes to which products are made and how they are to be bucked (length, price, etc.) can be made at any time, even when logging is under way. StanForD 2010 also introduces a separate message for controlling forwarders, which was not available in the earlier version.
- **Production reporting** from harvesters is per individu- ally- produced log, so production can be reported and analysed according to specific requests from, for example, the logging organisation and customer. In the future, the structure will also allow every log to be reported on-line. The detailed harvester information can also be used as a basis for making forecasts of forest fuel extraction and calculation of such product properties as density, heartwood content and knot structure. StanForD 2010 also introduces a message for reporting geographical information.
- **Operational monitoring** is done by registering each individual work process (harvesting, repair, mainten- ance, breaks, stoppage, etc.) for the driver and machine separately. The system is independent of the logging object on which the machine is operating at the time. This allows simple comparison of various time periods, so analyses can be made of different machine systems, logging teams, etc.
- The format in StanForD 2010 is **XML**, an open, general and well-established format, which is both easier for system developers and reduces the need to convert to other formats when StanForD 2010 data is to be processed in different data systems.

StanForD 2010 structures data in a number of messages for machine control, production reporting, quality assurance and operational monitoring.

Photo: John Deere

Photo: Log Max

Terms and concepts

- **Logging organisation** – The party responsible for logging – this may be the forest owner or an independent contractor
- **Delivery/Location** – Delivery refers to how various products are to be managed in forwarding (as separate product or combined with other products, e.g. as coniferous pulpwood) and location refers to a landing, i.e. a geographical point where the forwarded volumes are loaded onto the timber truck.
- **Object** – Defined area where a measure (e.g. logging) is to be carried out. The same bucking and forwarding instruction applies for the entire object. Normally, the entire object comprises a single contract in relation to the forest owner.
- **Subobject** – Smaller, defined part of an object, e.g. a stand. Subobject can also be used for separating volumes from different felling classes (thinning, final felling) on the same object.
- **Product** – A price matrix according to the older version of StanForD. Each product has its own definition.
- **Species group** – One or more species that are managed according to the same instruction. Linked to the species group are, for example, bark function and calibration data for the measurement system on the harvester. Typical examples of species groups for Sweden are spruce (*Picea abies*), birch (several species) or other broadleaves (several different broadleaves). Replaces ”species” in the earlier version of StanForD.
- **Key** – Usually a consecutive number that is set automatically by the machine computer to create traceability in the system. A Key is never reset, with the exception of SubObjectKey which is reset when a new object is created, and LogKey which is reset for each new stem.
- **UserId** – Identity that is set by the user of data, thereby allowing identification of every single machine, object, product, etc. Combining UserIds and Keys creates traceability of all changes made in the machine system.

StanForD 2010 – modern communication with forest machines

Modern forest machines for logging are equipped with machine computers. The software assists the operator when extracting forest products that industrial customers then process into sawn timber products, pulp or energy. The forest machines are controlled by digital instructions, and production data is stored in the machine computer. Most of the data flows from and between forest machines are managed according to StanForD, the standard for forest machine data and communication. Today, StanForD is a global standard and is used by all major manufacturers. Tree-length machines were included in 2019. The purpose of this introduction is to give a brief overview of the different components of StanForD 2010. A more detailed descrip tion of the standard and technical documentation is available from skogforsk.se.

Why a new version of StanForD?

StanForD has been the common standard for communication with and between forest machines since the end of the 1980s. The standard comprises a standardised file structure. A basic principle in StanForD has always been to offer full compatibility backwards, which meant that much of the standard is no longer used, as obsolete variables could not be cleared. Component variables needed to be reviewed and the standard needed to be transferred to a format that better corresponded with today's requirements and modern data management. The standard was also given better and more detailed descriptions of the structure, clear version management and prioritisations (rules for implementation). Consequently, the objectives of updating StanForD to StanForD 2010 were to attain:

- A standard for data management based on (simpler) structures in line with modern IT solutions.
- Better descriptions of the structures.
- Stricter prioritisations and rules for implementation.
- A system for version management of the standard.
- A clear-out of obsolete variables and structures that are no longer needed.
- A common and general format with an open interface (XML), thereby facilitating implementation of the standard in new applications, e.g. in new markets.

The first decision to update StanForD was taken in August 2006 and in the spring of 2011 the members adopted a decision on ver- sion 1.0 of StanForD 2010. A REST API was also included in the spring of 2021 making it possible to e.g. communicate through a cloud solution. The standard has thereafter been updated annually. The latest version is 3.6 (2020). This gave forestry a modern standard, based on XML, and greater capability to control forest machines, as well as store and utilise information from the machines in a flexible and effective way.

Photo: Ponsse

What is new in StanForD 2010?

The main differences between StanForD 2010 and the earlier version of the standard are shown in the following table.

Table 1. Main differences between StanForD 2010 and the earlier version of the standard.

Function	StanForD 2010	StanForD (older version)
Identities	Keys and UserIds enable separation of every single log produced globally.	Based on variable number and standardised sequences in lists.
Production control harvester	Separate messages for (1) definition of products and how they are to be prepared, (2) identity of the object and current products on the object, and (3) definition of tree species. The separate messages for control mean that a new pricelist can be issued and implemented directly during logging, allowing greater flexibility in production.	A complete new bucking instruction must be sent out, and a new object created, in order to change control of current production.
Production control forwarder	New messages with (1) identity and positions of object and landing, and (2) definition of how each product is to be managed when forwarding.	Only maps.
Production reporting harvester	Primarily at log level, i.e. data is stored and reported for each individual log and stem. New message for reporting geographical data.	Mainly as aggregated production data, although reporting per log is possible.
Production reporting forwarder	Several landings can be defined, allowing easier separation of volumes from the object by indicat- ing which landing they have been forwarded to. New message for reporting geographic data (same as for harvester).	Separate transport objects are used to separate volumes that are forwarded to separate landings on the object.
Quality assurance	One message for all quality assurance data relating to harvester measurement. New message for quality assurance of weighing devices on forwarders.	Ktr + stm files for quality assurance, harvester.
Operational monitoring	Registration of work periods for operator and machine per unit of time, thereby facilitating analysis and comparison of productivity between machine systems and logging teams, regardless of the object they are working on.	Registration of work periods linked to the object or time period, thereby making it difficult to analyse productivity indepen- dently from the object and reported time periods.
Format	XML	Own text format (ASCII)
File transfer protocol between calliper (or other equipment) and machine computer.	No standardised solution – no need.	Kermit
Version management	Version management introduced where machines with the same version of StanForD 2010 can be controlled with the same message, regardless of machine manufacturer.	None
Tree-length machines	The standard handle controlling, reporting and monitoring production from feller-bunchers, skidders and yarders.	None

Photo: John Deere

Why is StanForD 2010 a stronger tool?

The new format and partly new structure in StanForD 2010 gives forestry an even more powerful tool for controlling and analysing the work of forest machines in fine detail. The following is a description of some advantages with StanForD 2010.

XML-format

StanForD 2010 uses the XML format for storing information in a file structure. XML is an open, general format that is used in many applications where data needs to be stored and communicated. This can help avoid unnecessary conversion between formats in communication with different data management systems.

For software developers, XML has the major advantage in that there are already many complete and freely available solutions for reading and managing XML files, which saves time and development resources. In addition, files can easily be checked against the XML Schema to ensure that they comply with the standard.

Even if XML files are large, they are easy to compress with zip compression, which saves space and requires less transfer capacity. The compressed XML files are generally no bigger than the earlier StanForD files.

Flexible production control

In principle there are three different methods for managing digital production instructions in forest machines – manual management, the Apteri method and flexible control of the logging.

The simplest way, as in the earlier version of StanForD, is to manually send out production and object instructions to the machine before logging. When logging has been started on the object, the instructions cannot be changed because the structure is based on lists with a set sequence. This makes it impossible, for example, to add a new product to the list, because the sequence is then disrupted and the product code cannot be interpreted.

A variation on this method is the Finnish Apteri model where the machine has a database to which the logging organisation can send out new instructions as soon as they are modified. The latest version of the instruction is downloaded to the machine just before the start of logging. Changes cannot later be made in the instructions once the logging has started.

A third alternative is the flexible control that is one of the basic ideas of StanForD 2010. The method is based on the same principle, with a database as in the Apteri model, but instead allows the instructions to be updated at any time during logging. When a modified version of an instruction enters the database, the operator is asked whether he/she wants to update an existing instruction or reject the update. The flexible method allows the logging organisation to quickly redirect production by, for example, changing the length breakdown for a product or activate/deactivate certain products in line with changes in demand. It is the introduc- tion of Keys and UserIds, together with the default of production reporting per produced log, that makes the flexible method possible. Instead of a sequence in a list, it is now a Key that signals the conditions under which a stem is bucked into products.

Production data from several loggings can now be aggregated, even if different product instructions are used.

Detailed production reporting

In StanForD 2010 production reporting is at log level (hpr message), allowing more detailed analyses of the forest products. Each log produced is described with dimensions, etc. so reporting of the produced volumes can be customised. What is interesting for Sawmill A is perhaps less interesting for Sawmill B and not relevant at all for Pulpmill C, even if the logs originate from the same logging site. Continual reporting of production in combination with a flexible method of logging (see preceding section) allows customised production where lead times are short between a change in demand and a redirection of production.

Performance indicators based on detailed production reporting allow forecasts of forest fuel availability and provide information about the logging object that the landowner can use in forest management planning. Statistical models can be used to calculate properties such as density, heartwood content and knot structure in a delivery.

For planning of forwarding, reporting by log with possible associated time stamp and GPS position provides faster information about what has been logged during a certain time period and where timber can be fetched.

The latest standard version (3.4-3.6) also includes possibility to register information about stems felled and transported using tree-length machines.

Operational monitoring per time unit

Operational data in StanForD 2010 is registered per time unit, which means that production can be studied for any time period, regardless of the logging object on which the machine worked. One advantage of separating operational monitoring from the object is that, for example, time gaps are avoided when a machine is moved from one object to another and then back again. By not aggregating data in the harvester computer, relevant performance indicators can later be calculated for any object and/or time interval. Various machine systems, logging teams, etc. can be easily compared by drawing up time series and analysing production and standstill (see figure below).

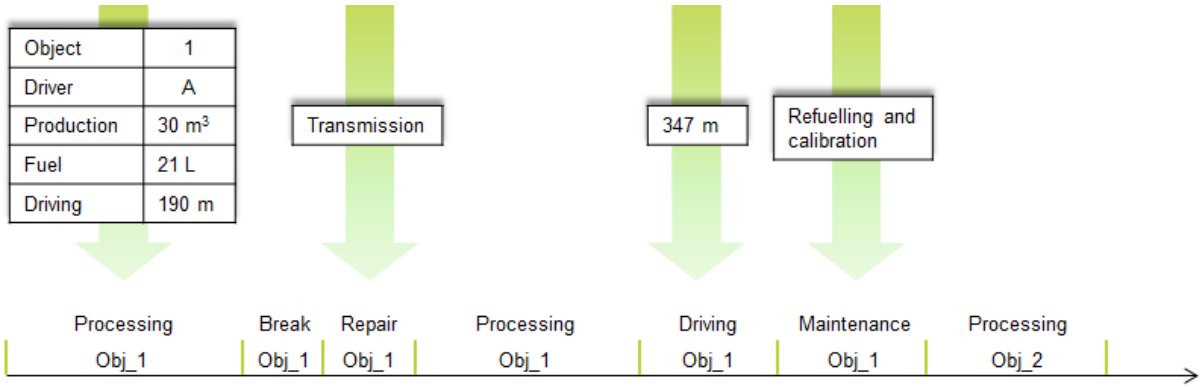

Figure 1. Example of information from operational monitoring according to StanForD 2010. Multiple data series can be combined, allowing detailed analysis of operations.

Photo: Rottne

Managing identities in StanForD 2010

StanForD 2010 has two ways of showing identities – Key and UserId. A Key is generated automatically in the machine, while a UserId is set by the logging organisation or any user of the data. By combining identities, every single log can be separated from all other logs produced globally. This structure is necessary in order to combine data from several different machines and yet retain information about individual logs, i.e. to avoid double counting and allow identification of missing logs. StanForD 2010 thereby creates a powerful tool for making extensive analyses of the logging work, with greater traceability in the machine computer.

Key

A Key is set automatically by the machine, usually a consecutive number. Every time the definition of a product, species group or operator changes, the relevant Key is updated so that the changes are easy to trace afterwards. The exceptions to this rule are ObjectKey, SubObjectKey and LocationKey, which are only updated when a new object, etc. is created. Every Key must be unique for a specific machine, and so is never reset. The exception is LogKey which is reset every time a stem is felled and SubObjectKey which is reset when a new object is created. MachineKey must also be unique for all machines globally (globally unique identity – GUID).

Table 2. Keys in StanForD 2010

Name	Comments
MachineKey	GUID for every machine. A new MachineKey is generated if the memory in the machine computer is lost for some reason (new hard drive, etc.) so that full traceability is maintained for all Keys generated in the machine..
StemKey	Consecutive number for every stem processed in a machine. Never reset.
StemBunchKey	Equivalent to StemKey, but applies to bunches of multi-tree handled stems. Every stem in the bunch also has its own StemKey.
LogKey	Consecutive number for produced logs that is reset for every new stem (butt log is always allocated number 1).
ProductKey	Consecutive number, never reset. Changed if definition of a product is changed.
SpeciesGroupKey	Consecutive number, never reset. Changed if definition of a species group is changed.
ObjectKey	Consecutive number, never reset. Generated when a new logging object is created in the machine computer.
SubObjectKey	Corresponds to ObjectKey, but applies for new subobjects. Reset when a new logging object is created.
LocationKey	Consecutive number, never reset. Created when a new landing is created in the forwarder.
DeliveryKey	Consecutive number, never reset. Changed if forwarding instructions are changed for a product or a group of products.
OperatorKey	Consecutive number, never reset. Updated if definition for an operator is changed.

UserId

A UserId is set by the user of data, usually the logging organisation, and can comprise letters, symbols and figures. UserIds are central in the control of harvesters and forwarders because they link information in different messages to each other. They also allow the user to identify, for example, an object or a machine. A UserId need not be unique, but in combination with the various Keys generated in the machine computer, every log, etc. will have a globally unique identity. The machine computer only accepts one instance of the same UserId, which means that if an update is sent to the machine, the new information will replace the old. An example is if the definition of a product is changed. When the new definition is sent to the machine, the time stamp on the new definition is read. If this is modified later than the definition in the machine, the new definition will replace the old. In other cases, the old definition remains unchanged.

Table 3. UserIds in StanForD 2010.

NamE	Comments
MachineUserId	Applies to a specific machine.
OperatorUserId	Applies to a specific operator.
ProductUserId	Applies to a specific product, i.e. a certain combination of product and price matrix/distribution matrix (e.g. small-dimensioned pine to a certain sawmill).
SpeciesGroupUserId	Applies to species group (e.g. pine, other broadleaves).
DeliveryUserId	Applies to a certain instruction about how products are to be handled in forwarding, i.e. which products are to be placed in the same stack when forwarding.
LocationUserId	Applies to a specific landing.
ObjectUserId	Applies to a specific logging object.
SubObjectUserId	Applies to a specific subobject.

Messages

The file structure in StanForD 2010 is based on a number of messages for control, production reporting, quality assurance and operational monitoring. In order to distinguish between various types of messages, a system of filename extensions is used.

Table 4. Messages in StanForD 2010.

File name extension	File type name	Function	Closest equivalent in the earlier StanForD
.pin	product instruction	Control	apt + ap1
.oin	object instruction	Control	apt + oai
.spi	species group instruction	Control	apt + ap1
.ogi	object geographical instruction	Control	ghd
.foi	forwarding instruction	Control	Ny!
.fdi	forwarding delivery instruction	Control	Ny!
.udi	user-defined data instruction	Control	Ny!
.hpr	harvested production	Production reporting	pri
.fpr	forwarded production	Production reporting	prl
.ogr	object geographical report	Production reporting	ghd
.hqc / .fqc	harvesting and forwarding quality control	Quality assurance	stm + ktr
.mom	operational monitoring	Operational monitoring	drf
.boi / .bpr	feller-buncher instruction and production		Ny!
.yoi / .ypr	yarder instruction and production		Ny!
.soi / .spr	skidder instruction and production		Ny!

Production control

StanForD 2010 contains a number of messages for controlling harvesters and forwarders via instructions that are sent out to the machine from an office computer. The messages for controlling the harvester have equivalents in the older version of StanForD, but those applying to the forwarder are new for StanForD 2010.

The biggest difference in control between StanForD 2010 and the earlier version is that the different types of control data are discrete, so that only a small part of the total instruction must be sent out if the production circumstances change during a logging. The system is thereby more flexible than the older system where a completely new bucking instruction had to be sent out if a change was made to, for example, which products are to be active (produced).

The following diagram shows the various messages that control harvester and forwarder in StanForD 2010 and their main contents.

Photo: Tigercat

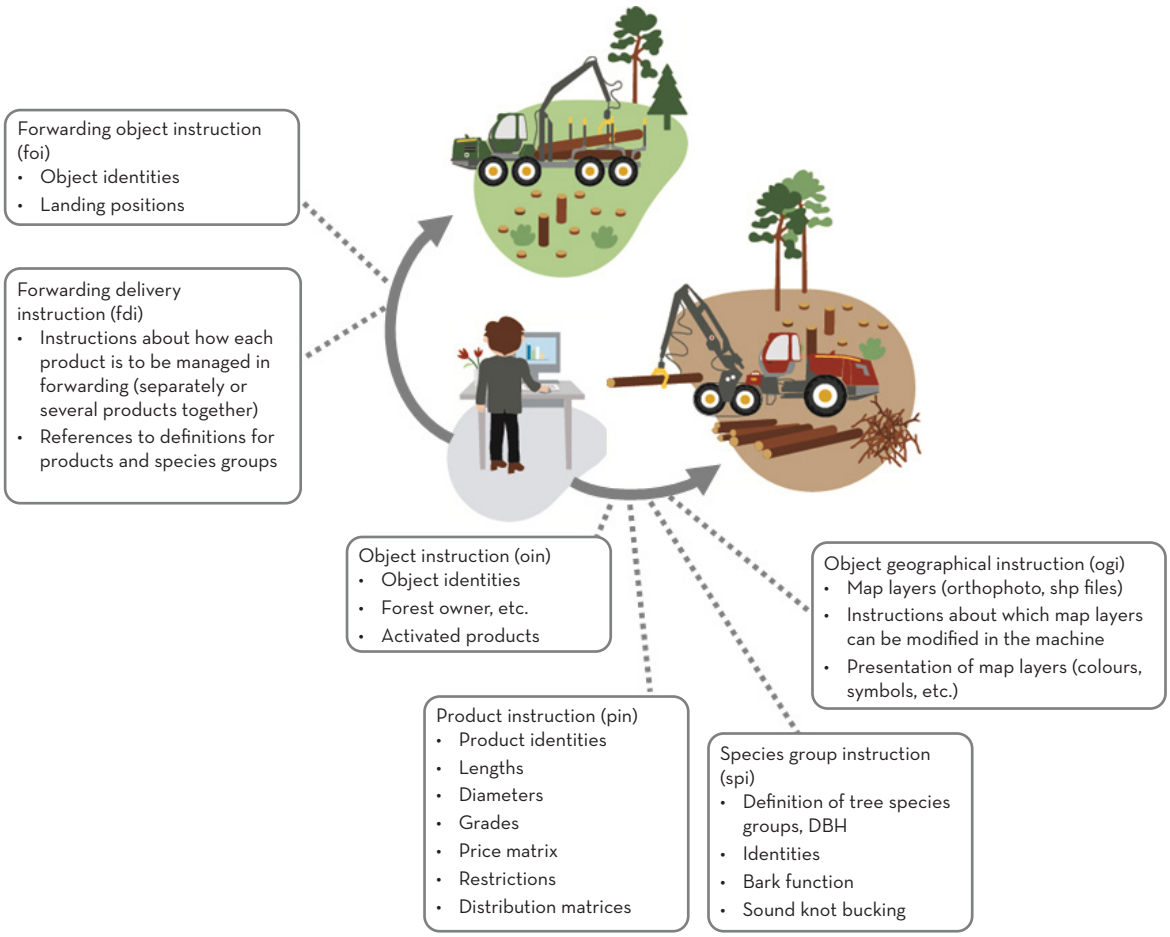

Figure 2. Diagram showing the various messages in StanForD 2010 that are used for controlling harvesters and forwarders.

Product instruction - pin

A product instruction includes information about how the har- vester computer is to manage diameters (diameter classes, type of measurement, min/max diameters, etc.) and lengths (length classes, maximum lengths, trimming allowance). The message also includes a price matrix and length distribution matrix, as well as applicable limits for specific products. A pin message contains no link to a specific object. StanForD 2010 supports a flexible method of working for logging which means, for example, that a new product instruction can be sent out and implemented at any time.

Every product is identified with a ProductUserId set by the logging organisation and a ProductKey that is set as a consecutive number in the machine (see description of identities above). The logging organisation controls whether the machine operator is to be able to modify the product definitions or not. Every modifi- cation of the definition of a product generates a new ProductKey.

Object instruction – oin

The object instruction contains the identities of the relevant log- ging object (set by the logging organisation) as well as information about the object name, logging organisation, seller and references (ProductUserId) to the products in question. However, preparation of the products is defined in the product instruction. If the object is divided into several sub-objects, there are also references to these.

Species group instruction – spi

A species group in StanForD 2010 can either be an individual species (e.g. *Picea abies*) or a group of species (e.g. other broadleaves). StanForD 2010 does not regulate the order in which the species groups are presented, which was the case in the earlier version of StanForD. Instead, this is up to the user, although it would be practical if, within a country or some other suitable region, agreements could be reached on some common species groups that are managed in the same way by all companies. For each species group, functions are defined that are to be used for calculating bark thickness, butt taper and sound knot limit. Breast height is also indi- cated, and the qualities included for a certain species group. With a flexible method of working, the species groups can be updated at any time during the logging.

Object geographical instruction – ogi

The object geographical instruction controls how the machine computer's GIS program is to manage and present cartographic material sent to the computer. The message contains information about which map layers (GIS files) are to be included, how the files are to be unpacked, how boundaries etc. are to be shown on the maps (symbols, colours, size) and which map layers may be chan- ged by the operator. This reduces the risk that digital maps cannot be read in the machine's GIS program. The standard enables every company to send out digital area directives showing all markings (object boundaries, retention sites, landings, etc.) presented in a manner determined by the company.

Forwarding object instruction – foi

The object instruction for forwarding contains object- specific infor- mation such as the object's identities and location of the landing.

Forwarding delivery instruction – fdi

The delivery instruction contains more general information for forwarding than the object instruction. This message can therefore be used for longer time periods without requiring updating. The delivery instruction contains definitions of product groups, which products the harvester has produced, and how these products are to be managed in forwarding (coloading of products, selection of landing). One example of a product group can be pine timber, which can comprise several different products, e.g. normal pine timber of various qualities. Each of these products has its own definition in the applicable product instruction.

Felling-bunching object instruction – boi

(object instruction feller-buncher, from version 3.5)

Objects instruction for tree felling that includes object specific identities and relevant species information.

Yarding object instruction – yoi

(object instruction yarder, from version 3.6)

Objects instruction for yarding that includes object specific identities and the location of landings.

Skidding object instruction – soi

(object instruction skidder, from version 3.6)

Objects instruction for skidding that includes object specific identities and the location of landings.

User-defined data instruction – udi

StanForD 2010 includes a flexible solution for sending company- specific forms for e.g. follow-up in digital format. The instruction defines user-specific tables and question- naires to be manually filled in by the operator. The manually registered data are returned from the machine as part of messages for either production reporting or operational monitoring. User-specific data for follow-up could be cleaning of understory, oil consumption, number of high stumps for nature conservation, information regarding landings etc.

Production reporting

StanForD 2010 is based on the principle that data is registered in the machine computer at high resolution, and then aggregated or further processed in the companies' own data management systems. The main option for production reporting from harvesters is therefore the hpr message where production is reported for each individual log. For the forwarder, every single load or part-load (when several products are coloaded) is reported as the smallest unit.

Harvested production – hpr

In production reporting for the harvester, detailed information is stored about every single processed log and stem in a structure similar to the older pri file type. All length and diameter measure- ments along a stem, and the quality, can be sent in the same way as an stm file. Every log is given a unique identity so that production from several machines on the same object can be reported in the same message, while retaining the possibility to trace every log to a certain stem and machine.

Multi-tree handled stems can also be reported in the same structure because every bunch (and every stem in the bunch) is given its own identity (StemBunchKey). Even unclassed logs are stored in the message, although with a smaller number of variables.

Forwarded production – fpr

Production reporting for the forwarder comprises a description of what has been forwarded (number of logs/ bunches, volume, weight) and where every load (or part-load) has been unloaded.

The production reporting also includes time stamps (start/stop) for each load and references to operator and logging object. The mes- sage also allows the reporting of current status, e.g. that forwarding has been completed for all or parts of the object.

Felled-bunched production – bpr

(from version 3.4)

Almost identical with harvester production (hpr) with the difference that only stems, not logs, are reported.

Yarded production – ypr

(from version 3.6)

Almost identical with forwarder production with the difference that stems, not logs, are transported.

Skidded production – spr

(from version 3.6)

Almost identical with forwarder production with the difference that stems, not logs, are transported.

Object geographical report – ogr

The ogr is largely similar to the object geographical instruction (ogi). In this message, information is stored about which map layer has been modified in the machine, how the map layer has changed, and who made the change.

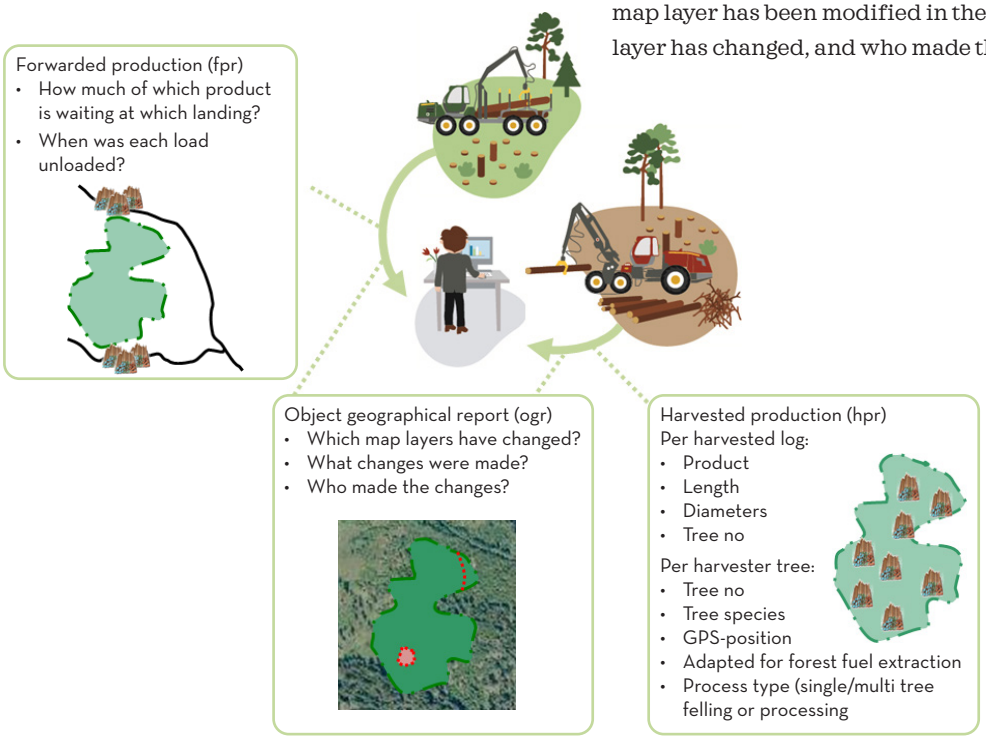

Figure 3. In StanForD 2010, production reporting from harvesters is per log in an hpr message. Geographical data is provided in an ogr message for both harvester and forwarder. The forwarder's production is registered per load (or part-load when a load is made up of several products) in an fpr message.

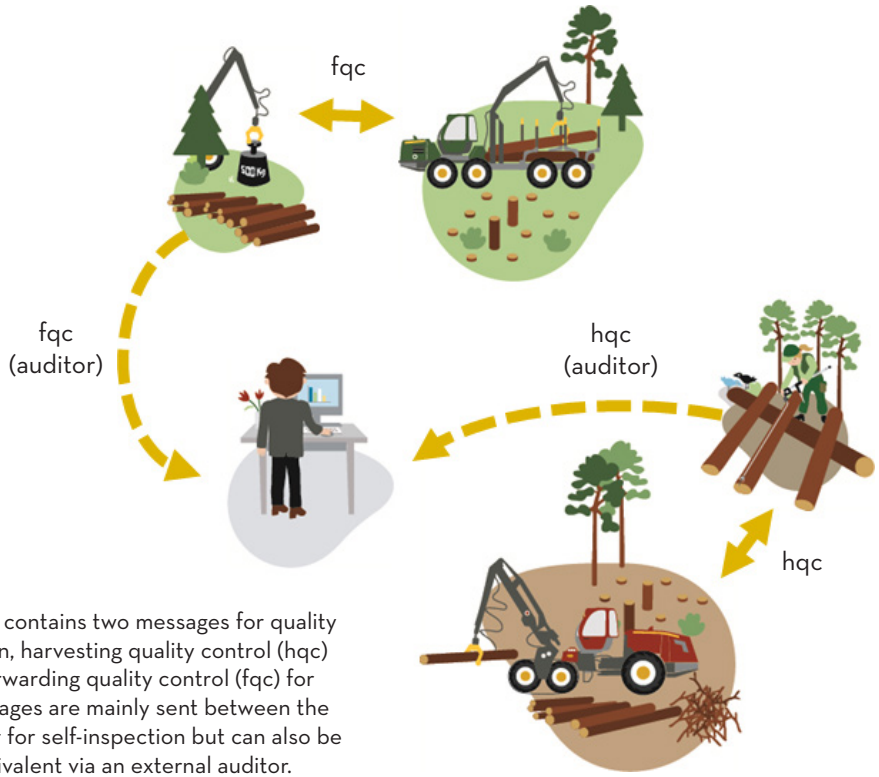

Figure 4. StanForD 2010 contains two messages for quality assurance and calibration, harvesting quality control (hqc) for the harvester and forwarding quality control (fqc) for the forwarder. The messages are mainly sent between the machine and the calliper for self-inspection but can also be sent to the office or equivalent via an external auditor.

Quality assurance and calibration

In order to ensure that the harvester and forwarder systems for measuring length, diameter and weight are accurate, there are procedures for assuring measurement quality. For harvester measurement, quality assurance includes making random control measurements of a number of stems and comparing the results with the machine data. An independent auditor making regular follow-ups can also be linked into the system. For the forwarder, quality assurance comprises checking any load-weighing equipment. Observe that quality assurance is under development also for feller-bunchers.

Harvesting quality control – hqc

In StanForD 2010, all data relating to the quality assurance system for harvester measurement is stored in an hqc message (replaces the earlier ktr + stm), meaning that the same control measurement message is sent both to and from the calliper. When a control stem is chosen randomly or manually for calibration, the stem vector with diameter values for every dm is sent in an hqc message to the calliper. In control measurement of the stem, the measured length and diameter values are stored in the same message. The message will also contain the calibration history. The hqc message has the same structure as the message for harvester production, but only includes stems that are selected for control measurement.

Forwarding quality control – fqc

In StanForD 2010 a new message has been introduced (fqc) which focuses on control and calibration of the weighing system on the forwarder. The message contains identities for the weighing device, date of control and calibration, registered measurement values for control weighing and reference weights, and information about how calibration adjustment was made.

Photo: John Deere

Operational monitoring

Automatic registration of the work of the harvester and forwarder enables monitoring of production and comparison between different machine systems and logging teams.

Operational monitoring – mom

In StanForD 2010 operational monitoring is registered per time unit, with references to harvesting object and machine operator. Data for e.g. a specific time period or harvesting object can then be summarised as preferred. The time is divided up into machine time and operator time, each of which is subdivided into processing, breaks, repair, maintenance, travel time, planning, etc. Unutilised time is also registered for the machine. The time series can then be drawn up for each separately and compared in the way required. StanForD 2010 contains flexibility to register either individual times or combined/aggregate times. The disadvantage of combi- ned times is that these make it difficult to compare operational monitoring data with production data and to calculate performance indicators for production.

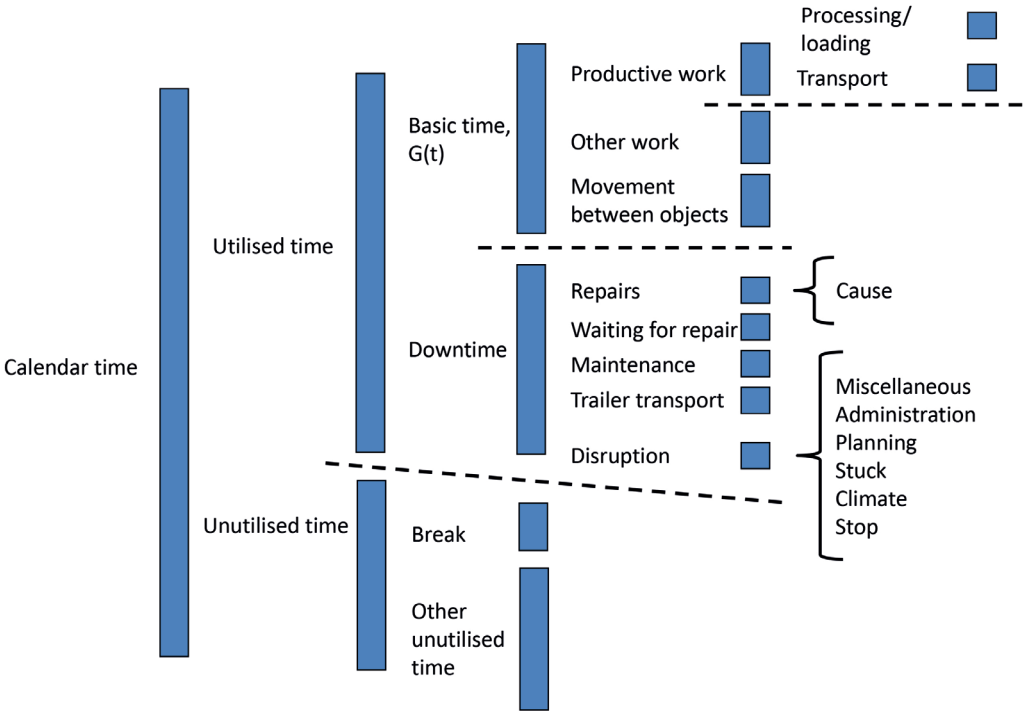

Figure 5. Registration of various types of time in operational monitoring, according to StanForD 2010.

Photo: Tigercat

Photo: Logset

Members and financing

Skogforsk is responsible for routine administration and development of StanForD, supported by Metsäteho in Finland. The work is jointly financed by machine manufacturers and the forestry sector in Sweden and Finland. Development work is carried out in close collaboration between machine manufacturers, forest companies, Metsäteho and Skogforsk, and meetings are held twice a year to discuss and decide on changes in StanForD and its development.

StanForD currently has fourteen members:

Biometria – CGI – Coiltté – Dasa Control Systems – ForestPHD
John Deere Forestry – Komatsu Forest – LogMax – Logset
Ponsse – Rottne Industri – SkogData – Technion – Tigercat

Do you want to know more about StanForD 2010?

More information about StanForD 2010, as well as technical documentation, is available from skogforsk.se/stanfod

If you hav any questions, please contact

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