

## THE DEVELOPMENT OF SIMPLE TOOLS FOR FORESTRY WORK IN FINLAND

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### SELOSTE:

#### *YKSINKERTAISTEN TYÖVÄLINEIDEN KEHITTÄMINEN METSÄTYÖHÖN*

The paper deals with the development activity of hand tools and their maintenance methods as well as the improvement of working techniques and methods in Finland in the era when forest work was exclusively or mostly done by muscular power.

Development activity was carried out in a close connection with professional training, permitting the development results to be distributed widely throughout the country at short-duration courses, and simultaneously collecting new information.

The phases of the entire development scheme were as follows:

- founding the development and training organization
- teaching the knowledge currently possessed
- inventory of the assortment of tool models, and the first selection of tools to be developed
- developing tools
- developing methods of tool maintenance
- developing working techniques and methods
- teaching the new knowledge gained in the development activity

For starting development work the first selection of tools to be developed was performed. Thus, there were effected

- an inventory of models of tools used in Finland
- selection of the best tools on the basis of working experiments and interviews
- standardization of the variety of models
- comparison of foreign and Finnish tools

On the basis of this, along with analyses and synthesis performed, new hand-made prototypes were created and then tested on forest work sites. Based on that knowledge, an tool factory manufactured test series. They were sent to an amount of skilled forest workers in order to receive practical information on the suitability of different models, steel qualities, tempering degrees etc. After that, on experience gained, best tools selected could be put into manufacturing.

With the designing and the usage of tools reciprocally influencing each other, it was natural that working techniques was also investigated.

The development of hand tools carried out in Finland would not have led to such good results unless firm cooperation had existed between researchers, users, manufacturing industry and trade as well as vocational training activity.

## THE DEVELOPMENT OF SIMPLE TOOLS FOR FORESTRY WORK

This is a story of the development of simple tools employed for forestry work in a northern country, in which the livelihoods of the people are largely dependent upon wood products. It is a story which dates back to the era when forest work was exclusively or mostly done by muscular power — the preparation of wood by man power, and its transport by man and horse. It is a story of experiences gained in a sparsely-populated country with wide forests, with the delivery of timber mainly being effected in winter, when small forest owners, relieved from farming work, were willing to earn extra income by forest operations with a view to raising the rentability of their holdings.

The era of development described lasted nearly 20 years. It ended at the time when machine power based upon cheap fuel began increasingly to supplant muscular power in forest work. Forest work then began to pass seasonal workers to all-the-year-round professional workers. Simultaneously, it reduced the amount of additional income to be earned, and the rentability of farms, and brought in its train migration to industrial occupations.

In many countries of the world, forestry work is still being done by muscular power, and consequently experience gained might still be of interest.

The story begins. The period concerned is that of the 1940's and —50's.

### The Starting Point

It was common knowledge that forest work carried out manually and without the proper tools is an extremely strenuous undertaking. On the basis of studies made abroad it was also known that forestry tools needed improvement, and that the efficiency of industrially-made axes and saws could be increased by extra maintenance and methods of sharpening.

In Germany, experiments and investigations had been engaged in as long ago as in 1860's, with a view to determination of the most suitable models of axes and saws. In Denmark, a list of forest tools to be

recommended was made at the end of the 1920's. In Norway, there was published a tool guide for forest workers at the end of the 1930's. Towards the end of the 1930's investigations into forest work were started in Sweden. These investigations demonstrated that if well-maintained tools were employed, the output of work was raised by 12–13%. In some cases, good tools augmented productivity even as much as 25–30%. Furthermore, it was found that the best loggers could bring about the most marked increase in their work output. In Sweden, by the end of the 1930's increasing attention was being paid to the development of tool maintenance.

To keep the country's independence, Finland was forced to engage in the Winter War of 1939–40, and the Continuation War of 1941–44. The Winter War, and in particular the following Continuation War involved a shortage of firewood, building timber, and raw material needed by industry. This led to a part solution in the founding of a new organization in 1942, to provide instruction in the maintenance of tools, and to promote the development of forest work. This organization was the Forestry Department of the Work Efficiency Association, which received financial support from the State from the very beginning. Finnish instructors were trained with the help of knowledge and skill imported to them by an instructor from the Swedish steel factory Sandvikens AB.

During the next two decades, short courses in tool maintenance and forestry work were arranged for about 30 000 forest workers and other professionals.

It rapidly became apparent that it was necessary to develop further new tools, their maintenance, and working techniques. Development activity thus took many forms.

The phases of the entire development scheme can accordingly be differentiated as follows:

- founding the development and training organization
- teaching the knowledge currently possessed

- inventory of the assortment of tool models, and the first selection of tools to be developed
- developing tools
- developing methods of tool maintenance
- developing working techniques and methods
- teaching the new knowledge gained in the development activity.

The first two phases have already been mentioned.

### The First Selection of Tools to be Developed

Habits and attitudes have traditionally been passed on from father to son — particularly prior to the modern era of electrical information. In addition to the temporal development phase there is a geographical tradition, which locates the usage and development of certain tools within the areas restricted by national borders, mountain ranges, river valleys or seas. And, of course, the stage of technical development, and the economic system of the society for their part speed up or retard development.

These factors, linked with time, create the background for each situation of development. A generation ago trees were commonly felled by axe. The lumberjacks of that time burst out laughing when the first felling saws were brought to forest work sites. Must we really rub a piece of iron through the tree when we can easily fell it with an axe? The handsaw has already gone through its era of development in many countries, and had also passed its peak period.

When timber and pulpwood are being made manually, the axe and saw are used for 20–50% of the whole working time. Let us thus take a look at the history of development of these tools.

In little Finland, with some 4 million inhabitants, in the 1930's there were two axe factories, which produced 54 different axe models. The axes differed from each other mainly in regard to weight and shape. They were manufactured for sale in different regions of the country by reason of the traditional demands created by the local

village smiths. According to an ARO study (1941), in 1935 80% of the products of one Finnish axe factory and 16% of the other, along with 4% of foreign and other axes, were in use in the Finnish work sites. As concerns saw blades, 90% were the products of two Swedish factories, 3% were Finnish, and 7% miscellaneous products.

For the establishment of a starting point for development work, an inventory of forest tools in use was begun in spring 1942. This was compiled by the Work Efficiency Association in conjunction with courses held in different parts of the country. Separate experiments were also undertaken to determine the most suitable models. This activity led to selection of the debranching axe and splitting axe as standard axes — only two models from each factory. The recommendation was given to the factories that they concentrate their manufacture on these models (SEPÄNEN 1946).

Two standard models came into general use, and made the starting point for the further development of axes. Simultaneously, information was collected on foreign axes and other tools.

As regards saw blades a great variety existed in Finland. Their length, breadth, thickness, the diameter of blade holes, and their mutual distance, as well as the shape, height, mutual arrangement of teeth, and so on, varied greatly. However, the saw industry was strongly invigorated during the war, and all factories continuously developed their models. As a result, the new models coming to the markets were generally better than the previous ones, which entailed that no grounds existed for reduction of the variety of models through selective investigation. Instead, it meant the standardization of saw blades with the intention of diminishing the variety of blades — but on such a scale that the process of development would not be checked. Thus, officially the only points standardized in Finland were the alternatives for length and breadth of blades, as well as the diameter of fastening holes and the distances between them.

In the first selection of tools to be developed, accordingly, there were effected

- an inventory of models of tools used in Finland
- selection of the best tools on the basis of working experiments and interviews
- standardization of the variety of models
- comparison of foreign and Finnish tools.

The best alternatives determined in this way were used for furthering of the essential development.

### Development of Tools

The organization engaged in development work was so constituted that it not only ran vocational courses, but also carried out tool development. In other words, the training organization was built up in such a way that it was able to conduct development activity.

### DEVELOPMENT OF AXES

The development work as concerns axes and debarking tools was effected in close cooperation with the largest axe factory in the country, Oy Fiskars Ab. When concise, practical results were attained with hand-made prototypes on forest work sites, the axe factory manufactured test series in accordance with the requests made to them. Test series were then sent to forest work

### DEVELOPMENT OF AXE-HANDLES

In the 1940's and still to some extent in the 1950's, there was a time in Finland when forest workers themselves made the handles for their axes and the frames for their bucksaws from wood. As a consequence, a great deal of attention was paid to the development of suitable models.

Thanks to this development work, there was created a wooden axe-handle model - made of birch - which was sturdy, and which met the ergonomic demands already that time. The handle was curved and egg-shaped in profile which made it flexible

Those to be trained as teachers for the courses of tool maintenance, were selected from among the best forest workers on the foundation of national logging competitions. These men were presentable, and had high professional know-how, high levels of skill in carpentry, and unprejudiced attitudes.

They were employed in the development work so that their experience, points of view and knowledge were gathered together. Further to this, they collected information from different parts of the country. On the basis of this information, along with analyses and syntheses performed by foresters of foreman level, new models were created in cooperation. Prototypes were made manually and then tested on forest work sites. Some examples of this activity may be mentioned.

sites, for use without charge, with the proviso that after a certain period of usage, experimental results, would be received in regarded to test tools. This system worked out well. By its application, practical information was rapidly gained on the suitability of different steel qualities, tempering degrees and models.

and of adequate strength. The end part of the handle was shaped to prevent the compression and straining of fingers, and its head was designed to diminish the danger of slipping. This type of axe-handle was also brought to the stage of industrial manufacture. Since axe-handles made manually could be made of better selected raw materials, and completed more precisely, hand-cutting was recommended for a long time, although the industrial products were already on the markets.

### DEVELOPMENT OF SAW-FRAMES

In Finland, large logs were obtained by two-men felling saws. The Canadian one-man cross-cut saw did not have time to break through before power saws appeared in the mid-1950's. Instead, even at the beginning of the 1950's, logs and fibrewood were made by bucksaws, with blades which could be tightened by wooden, usually home-made frames.

Development work on wooden saw-frames was pursued in similarity to the development of axes already mentioned. Drawings of the models developed were then made and then distributed to forest work sites. Forest workers usually whittled the wooden frames to fit their saws. Additionally, an agreement was made for the industrial manufacture of wooden saw-frames, in accordance with the models developed by the Work Efficiency Association. They soon became popular among Finnish forest workers.

In Sweden, steel frames were in general use. However, in Finland they were not regarded as suitable, as the blade could not be tightened to the same extent as in the wooden frames. To illustrate this difference LEVANTO (1955) made mechanical measurements of tensity in laboratory tests. A few typical test results concerning the comparison of 3 1/2-foot saws may be quoted:

	Highest breaking tension, kp	Highest normal tension, kp
Finnish wood frame .....	710	397
Foreing steel frame .....	329	173

This amazing result achieved in 1955 led to foreign steel factories also beginning to strengthen their steel frames. Before long it was possible to tighten the blades to an adequate extent. As a consequence, the steel and light metal frames pushed wooden frames out of the market within the course of a few years.

These examples will illustrate that, following the first selection, the actual phases of tool development have been as follows:

- the compilation of practical experience in regard to the tool models selected for comparison

- planning of prototypes, and their manufacture in cooperation with factories
- testing and improving test prototypes
- experiments with test series on forest work sites, for the comparison of steel qualities, tempering degrees, and different models
- laboratory tests on factors to be investigated
- publication of the results of investigations, and practical experiments, along with constant observation of the quality of products on work sites.

Furthermore, it may be emphasized that firm cooperation between the factories and forest vocational schools concerned has been a prerequisite of good results being achieved.

### Development of Maintenance Methods

In this context, it is impracticable to enter into the development of methods for tool maintenance. All that may be stated here is that the development of maintenance methods enabled the achievement of improved results with less muscular power, and increased safety in forest work.

As early as in the 1940's Finland developed her own methods and equipment for maintenance by reason of the difficulties experienced in the import trade after the war. In the hands of professionals, the techiques of maintenance were developed to a stage of precision adjustment. The importance of small details was often discussed in the columns of forestry periodicals.

The details were also discussed between the forest professionals of Finland and Sweden. The major question was whether the teeth of a saw blade should be filed along its whole length, or only along one third of the length. The influence of saw maintenance was also tested in Finland by ergographical means.



## Development of Working Techniques and Methods

With the designing and the usage of tools reciprocally influencing each other, it was natural that working techniques were also investigated. This was effected the separate analysis of each phase of work by application of the TWI (Training-Within-Industry)-method.

By analysis of the parts of each working position and movement, the key points and the ergonomic aspects, a suitable working technique was created for the use of the tools developed (KANTOLA—GRANVIK 1950). Courses arranged by the Work Efficiency Association, along with guides published, permitted of the new working techniques being distributed widely throughout the country, and also aroused interest abroad.

## Teaching of the New Knowledge

In conclusion, it may be stated that the development work carried out in Finland would not have led to such good results unless firm cooperation had existed in

bringing the tools developed into manufacture and practice. In this case, success was attained because the development organization and the training organization were the same, and the industry in the field engaged in active participation in the development investigations.

As a consequence, the information received from both users and manufacturers, along with the experience gained, could be used successfully in development work. Additionally, the new tools and working methods could be brought to the knowledge of forest workers, forest employers, and the trade, without any difficulties.

On the basis of this experience, it can be concluded that in the development of simple tools, it is to be recommended that as firm cooperation as is practicable be established between the development and training organizations. It is of value if the compilation of experience and of needs can be arranged in conjunction with the training activity. Moreover, the new results of development work should continuously be made available for application in the training activity. Firm cooperation with the manufacturing industry and trade is also of importance.

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## SELOSTE:

### YKSINKERTAISTEN VÄLINEIDEN KEHITTÄMINEN METSÄTYÖHÖN

Esitelmä käsittelee metsätyökalujen ja niiden huollon sekä työtekniikan ja työmenetelmien kehittämistä Suomessa 1940- ja 1950-luvuilla, jolloin metsätyöt tehtiin yksinomaan tai pääosin lihasvoimin.

Selostettu kahden vuosikymmenen kehittämis-

kausi päättyy aikaan, jolloin halpaan polttoaineeseen perustuva konevoima alkoi lisääntyvästi korvata lihasvoimaa metsätyössä. Tällöin kausiluonteisesti metsätyössä toimivien maanviljelijöiden tilalle alkoi lisääntyvästi tulla ympärivuotista ammattimetsätyöväkeä. Metsätyöstä saatujen sivu-

ansioiden väheneminen ja samalla maatilojen kannattavuuden pienenevä puolestaan voimisti muuttoliikettä maaseudulta teollisuuskeskuksiin.

Suomessa metsätyökalujen ja metsätöiden voimakas kehittämisvaihe alkoi sodan aikana v. 1942, jolloin perustetulle Työtehoseuran metsäosastolle annettiin alan kehittämis- ja kouluttamistehtävä. Seuraavan kahden vuosikymmenen kuluessa Työtehoseuran metsäosaston ammattiohjeet antoivat lyhyillä työkalujen kunnostuskursseilla ja muilla metsätyökursseilla opetusta 30 000 metsätyöntekijälle ja muulle ammattimiehelle. Kehitystyötä tehtiin näiden kurssien kokemuksia hyväksi käyttäen. Toisaalta kurssitoiminta tarvitsi uutta tutkimustietoa työkalujen kunnostuksesta ja työtekniikasta. Sama organisaatio suoritti nämä molemmat tehtävät.

Kokonaisuudessaan kehittämisohjelman vaiheet olivat seuraavat:

- kehittämis- ja koulutusorganisaation luominen
- olemassa olevan tietouden opettaminen
- maassa käytettyjen työkalumallien inventointi ja kehitettäväksi valittavien työkalujen alkuvalinta
- työkalujen kehittäminen
- työkalujen kunnostusmenetelmien kehittäminen
- työtekniikan ja työmenetelmien kehittäminen
- kehittämisessä saavutetun uuden tietouden opettaminen

Valittaessa työkaluja kehittämisen kohteeksi suoritettiin

- Suomessa käytettyjen työkalumallien inventointi
- parhaaksi koottujen työkalumallien valinta työkokemusten ja haastattelujen perusteella
- työkaluvalikoiman pienentäminen muutamaksi standardimalliksi
- ulkomaisten ja kotimaisten työkalujen vertailu. Tämän perusteella ryhdyttiin tutkimustyöhön. Sen analyysien ja synteisien perusteella tehtiin

käsityönä erilaisia työkalumalleja, jotka testattiin rinnakkaiskokeissa metsätyömailla. Parhaiksi havaituista malleista toisena kehittämispuolena toimiva työkaluteollisuus teki asianomaisia koesarjoja, joita testattiin käyttökokeissa metsätyömailla. Kokeneiden metsureiden työssä saatiin numeroiduista koekappalaista arvostelut mallien sopivuudesta, kestävyvyydestä tai erilaisista teräksen karaistusasteista yms. ominaisuuksista.

Näin eri puolilta saatujen mielipiteiden, käyttökokemusten sekä omien vertailevien kokeiden ja myös laboratorioskokeiden avulla saatiin perustamallien kehittämiseksi sekä niiden laadun saamiseksi mahdollisimman hyväksi. Työtä jatkettiin vuosien mittaan varsinaisten valmistussarjojen yhteydessä mm. työkalukursseilla saatuja kokemuksia ja arvosteluita hyväksi käyttäen. Saman organisaation tutkimus- ja kehittämistoiminta täydensivät toisiaan sangen taloudellisella tavalla kun kehittämisessä olivat samanaikaisesti mukana asianomainen työkaluteollisuus, markkinointi ja käyttäjäkunta. Työn tulokset julkistettiin tutkimusjulkaisuissa ja myös käytäntöön levitetyissä työoppaissa.

Kehittämisen kohteena olivat kirveet, kirvesvarret, puiset sahan kehykset ja metalliset sahankaaret, kuorimaraudat, petkeleet, nostokoukut, nostosaket, istutuskuokat, vesurit yms. metsätyökalut.

Työkalujen kehittämiseen liittyi olennaisesti myös niiden kunnostuksen ja kunnostusvälineiden kehittäminen. Sen jälkeen luotiin fysiologisiin perusteisiin nojautuva uusi työtekniikka puun miesvoimaisessa kaadossa, karsinnassa, katkonassa ja kuorinnassa. Siten kehittämis työ jatkui työmenetelmien parantamisena.

Tässä kehittämisessä saadun kokemuksen perusteella voidaan todeta, että kiinteä yhteistyö kehittämis toiminnan ja koulutustoiminnan kesken edistää hyvien tulosten saavuttamista.