

## Ways in Introducing Modern Technologies in Slovenian Forests with the Emphasis on Logging by Harvester and Forwarder

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### **Abstract:**

*Introduction of something new into usual routine of work and thinking is always difficult because it may mean a lot of abstruseness and fear of unknown and unintended consequences. On the other hand we must not neglect uncertainty because of deficiency of knowledge about issues, which so far haven't been common in a specific environment. In spite of traditional (positive) conservatism, changes happen in forestry and they strongly affect different work fields. The most recent big move in Slovenia is the introduction of new logging technologies, which has happened in the last decade. We are speaking of introduction, which literally means a planned approach. Otherwise the use of such technologies would probably lead to strong rejection of the professionals as well as the public. The forestry profession in Slovenia has realized that in this case an integral approach is necessary. Different stakeholders were actively involved. The most significant events were designed as workshops, which were composed from theoretical and practical presentations. Theoretical experiences originated from foreign literature and domestic research projects. They treat different topics: the suitability evaluation of cut-to-length in Slovenia; labor costs in diverse forest work conditions by mechanized cutting operation and the influence of fragmented private forest property on mechanized cutting. Workshops started in 2002 and till 2010 in Slovenia five such events were organized. At workshops forestry professionals and non-professionals had the opportunity to express their opinions about advantages and disadvantages of new logging technologies. Through participatory process, which was also part of workshops, participants had opportunity to give suggestions of how to make the introduction of modern technologies suitable for Slovenian conditions. For the profession these suggestions were binding, even though informally, and the results of the achievements were publicly presented. Besides the organization and the results of the workshops, the article presents also the development of the participants' perspective of the use of new technologies, comparatively before its start in 2002, when for the majority the technology was still unknown and eight years later when the perspectives are based on certain practice and experiences.*

**Keywords:** contemporary forestry technologies, logging, introduction of technologies

### **1 Introduction**

History teaches us that a divided kingdom does not endure therefore the awareness of the Slovenian forestry profession that in such crucial times, as introduction of mechanized cutting is, integral and united approach is necessary, is positive. This was done and is being done in cooperation with all the important forestry stakeholders. A planned approach in Slovenia started with common events, mostly workshops, where problems were dealt with theoretically and practically in different ground and stand conditions. In the period from 2002 six workshops and a seminar were organized, which shows our awareness of the importance of the problem. These events gave the forestry and non-forestry stakeholders an opportunity to express their opinions about advantages and disadvantages of mechanized cutting and gave suggestions what to do to make its introduction adequate to Slovenian conditions. These suggestions were binding for the organizers, even though informally, and the results were later presented to the public:

⇒ Maps of areas suitable for mechanized cutting were made;

- ⇒ Temporary instructions for the preparation of worksites were issued;
- ⇒ Certain changes of legislation were made;
- ⇒ A manual Safe work in the forest – Code for safe work (ILO) – which also deals with mechanized cutting, was issued;
- ⇒ A lot was done in the area of education and informing of professionals and the public.

The use of mechanized cutting has become a regular feature in Slovenian forests. Through its more and more frequent use it has also become more visible and thus subject to critical judgement of the professionals as well as the public whose reactions were often justified.

### 1.1 Development of the use of modern technologies in Slovenia

A study about the possibilities of use of mechanized cutting in Slovenia from a decade ago (Krč and Košir 2002), was based on the data of the Forestry information system. Evaluation of stand selection, potentially suitable for mechanized cutting, was done. According to the initial selection of input variables, expectations of the quantity of modern machinery in forest operation and the quantity of wood, cut in this way in Slovenia, proved to be very careful. This is undoubtedly reflected in the data about quantities cut and level of modern technology equipment of contractors too. In continuation, we'll use the expression mechanized cutting – MC which is asserted in Slovenia and encompasses cutting with harvesters and skidding with forwarders and also includes cable yarders equipped with processor head. Cutting with modern technologies is increasing and in a chronological overview of its use we can notice great rises in times of bigger breaks in forests when mechanized cutting has proved to be safer and more efficient. Likewise, the level of equipment with modern machinery of forest work contractors is increasing (forest owners, enterprises, companies), stimulated by the possibility of co-financing their purchase through the European Agricultural Fund within the Program of Rural Development 2007 – 2013 PRD.

The first use of a harvester dates back into 1996 and until 2002, MC was more or less used in isolated cases of redevelopment after natural disasters or after diseases. The first important step was made in 2001 when farmer Moličnik bought a second hand harvester which was a signal to other contractors that in the area of equipment they would have to keep in step with the times and for the public forestry service, i. e. Slovenia Forest Service, a clear signal that in the area of forest management MC would have to be counted on.

Figure 1 shows that the use of MC started growing after 2002 and in continuation shows a trend of growth. Until 2011, more than 1 million cubic metres of wood were cut with MC, most of it in state forests, except in 2008 when more wood was cut in private forests with MC. In that period there were big storm damages in forests in some parts of Slovenia and thanks to good organization and especially planned promotional role of the Slovenia Forest Service (SFS) regarding the adequacy of the use of MC in such cases, restoration in small scale property was done also with MC (Gerl and Brguš 2010).

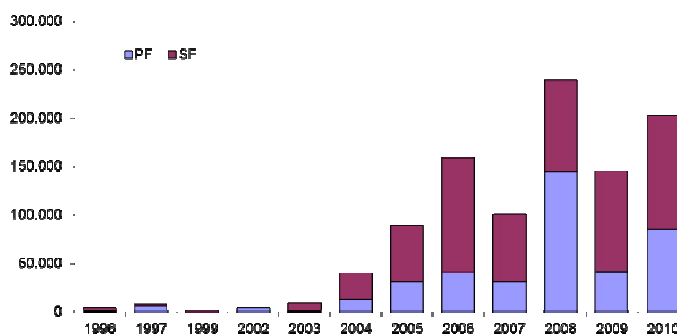
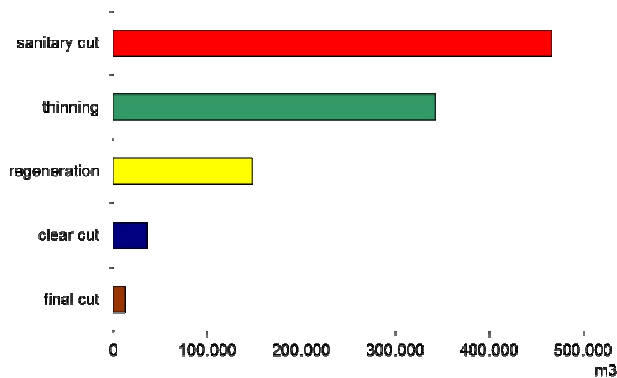


Figure 1: Wood cut with MC in Slovenia according to years and ownership (PF – private owned forests, SF – state owned forests)

According to the type of cut it has been said several times that MC has mostly been used for salvage cutting but slowly thinning and other types of cutting are growing, too. Until 2011, more than half of wood was cut within other types of cut which shows that MC has been asserted also in regular cutting (Figure 3).



**Figure 2: MC in Slovenia according to type of cutting**

In regular cutting operations, quantity and intensity of cutting are important factors which affect the decision about the use of MC (Krč 2004; Krč and Košir 2004). Additionally, the quantity and intensity of work with MC depend on the size structure of the private forest property in Slovenia (Krč 2006).

As to technological combinations, harvester – forwarder and cable yarder system with processor prevails. This does not comprise tractor forestry log trailers which have lately become more and more popular by private forest owners. In Slovenia, tractor forestry log trailers are treated as small forwarders because they enable skidding on wheels. The level of mechanization which enables the MC technology is shown in Table 1.

**Table 1: Number and types of mechanization in Slovenia allowing MC (till 2011)**

Type of mechanization	Number
Harvester	18
Forwarder	11
Harwarder	1
Cable yarder with processor head	9
Forestry log trailer for tractor	68

## 2 Material and methods

As shown in the chapter dealing with the development of MC technologies in Slovenia, development is happening, technologies are present in Slovenia, and have to be counted on. The use of MC means a strong and radical professional and thinking leap. This goes especially for environments and professions which are traditionally oriented towards a positive and careful conservatism which we can certainly say for forestry. Introduction of new technologies undoubtedly means a strong intervention into traditional ways of forest management and thinking patterns and has a strong influence on the perception of broader public who is extremely sensitive and critical about actions in the forest.

When we faced MC in Slovenia, we had two possibilities, professionally speaking (passive and active):

- ⇒ to wait what would happen in forests regarding the use of MC and watch how the professionals and public would react, or
- ⇒ to pass the uncontrolled development with an adequate approach and to avoid emotional reactions which means to include all stakeholders into discussion and find, together with them, common and forest friendly directions, binding for the profession, which would, at the same time, actively involve all stakeholders into co-responsibility to design adequate solutions.

We decided for the second option and thus we chose the approach which is probably rare in the world but probably the only possible one for Slovenian conditions. The process, which can be called professional participatory approach, started in 2002 and lasts until today. Figure 4 shows the steps that have been made.



**Figure 3: Steps made for the introduction of new technologies in Slovenia**

## 2.1 Workshops

The main method of the participatory approach were workshops, started by SFS. At the very beginning SFS found out that it wouldn't succeed without integration of all Slovenian forestry stakeholders. Therefore SFS continued the cooperation with other forestry institutions, work contractors and forest owners and thus reached an important professional cooperation between different subjects in forestry. Every workshop dealt with certain technological and silvicultural topics, and were located so that they practically covered all important silvicultural sites in Slovenia.

Why workshops? Workshops enable an active approach which connects the participants over a certain question. We were always aiming to reach a consensus of the participants, selected from all forestry stakeholders and from the broader public. The workshops consisted of a theoretical part, lectures and practical demonstrations in the field. Some of them had the participatory part, too. Through lectures and field demonstrations participants gained certain knowledge and were able to interchange experience. In the participatory part, participants got the opportunity to express their views about a certain problem. They coordinated and gave solutions or directions to the organizers and consecutively to the profession and politics, what needed to be done to perform MC in Slovenia according to close-to-nature standards of forest management. Thus we wanted to outdo irrational and emotional reactions of the profession and the public which usually appear with radical changes of working methods, which MC certainly is.

As shown in Figure 4, we have so far carried out 5 workshops which contents, place, number of participants, number of papers, number of practical demonstrations and the participatory part are shown in table 2.

**Table 2: Review of workshops by introducing MC in Slovenia**

Year	Region	Title/content of WS	No. of participants	No. of papers	No. of practical demonstrations	Participatory approach
2002	Nazarje	Introduction of mechanized cutting in Slovenia	50	2	5	1
2003	Bled	Possibilities for mechanized cutting	103	8	3	
2004	Postojna	Mechanized cutting of timber wood	96	6	3	
2005	Kočevje, Novo mesto	Mechanized cutting in sanitary cut for bark beetle and mechanized cutting of deciduous trees	112	9	8	
2010	Murska Sobota, Maribor	Aspects of use of modern cutting technologies	153	8	9	1
<b>Total</b>			<b>514</b>	<b>33</b>	<b>28</b>	<b>2</b>

More than 500 participants took part in the workshops, 33 professional papers were presented and foresters prepared about thirty practical demonstrations. Workshops enabled a big professional impetus on all levels of forestry and from this point of view they contributed to professional development and improvements.

## 2.2 Participatory methods

An essential part of the workshops were objections and directions of participants to organizers regarding what needed to be done to make the introduction of MC coordinated with the forestry doctrine as much as possible and at the same time economically justified which is one of the most important reasons for such an investment. We got the directions on the basis of participatory methods, which enabled every participant to express his view and the obtained directions were binding for the profession and the politics to follow and implement them to the greatest extent possible.

We were also interested in the development of participants' attitude towards the use of MC and most of all development of this attitude in a certain time distance, in the sense of positive or negative perception, which will be shown in continuation.

As shown in Table 2, two workshops dealt with the attitude of participants towards the problems of introduction of MC and their suggestions to improve the situation, one in Nazarje in 2002 and the last one in 2010. The structure of used methods was similar at both workshops and comprised:

- ⇒ Visualisation (usually field presentation)
- ⇒ H diagram
- ⇒ Pair ranking of group suggestions
- ⇒ Presentation of suggestions

### 2.3 H diagram

This participatory method (FAO 2011) is an excellent tool to establish an individual attitude of each participant towards a certain problem, their negative and positive opinions and to find out solutions to improve the situation. Participants are divided into small groups (4 to 5 participants in each group) at random which enables us to shatter former connections and make them face other opinions and respect them. A big sheet of paper is divided into different fields which form a letter H and put the central question on it (figure 4). Above the connective line between both verticals we put 0 to the left and 10 to the right. Each participant must give his own estimation, between 0 and 10, of what he thinks about the situation in question. Then each participant writes several arguments why he hadn't given estimation 10 (usually self adhesive notes are used) and sticks it to the left side of the paper. After that, he arguments why he hadn't put estimation 0. Individual work is finished at this level and they start to work as a group. They put together equal or similar opinions on the left (negative) and on the right (positive) and make comments. The next step is a determination of the collective estimation (framed number 4 in Figure 4) which cannot be the arithmetic mean of all the individual estimations but a collective, democratically determined estimation of the group. At the end, the group has to give suggestions (usually 4) how to move the group estimation towards 10.

<p><b>WHY NOT 10</b></p> <ul style="list-style-type: none"> <li>• A high % of the ground required for skidding tracks</li> <li>• It cannot be used on all types of terrains</li> <li>• A high % of steeply sloping land in Slovenia</li> <li>• Copying the West of the "developed"</li> <li>• High investments</li> <li>• Complicated organization of work at all levels</li> <li>• It requires high concentration and a high rate of working hours to be economical</li> <li>• Higher intensity of tree marking</li> <li>• The carriers of technological development are inadequately distributed</li> <li>• Ecology</li> <li>• Sustainable concept, lower concentrations</li> <li>• Stand damages</li> </ul>	<p><b>"How do you assess the introduction of harvesting in Slovenia?"</b></p> <p style="font-size: 2em;"><b>7,0</b></p> <p><b>0</b>                      <b>x x</b>                      <b>xx</b>                      <b>10</b></p>	<p><b>WHY NOT 0</b></p> <ol style="list-style-type: none"> <li>1. Ergonomics</li> <li>2. Motivation of young people for working with machines</li> <li>3. A substitute for manpower shortage.</li> <li>4. It requires more professional work</li> <li>5. Sweat labor is replaced with "attractive work"</li> <li>6. Technological development</li> <li>7. Higher efficiency</li> <li>8. Differentiated approach</li> <li>9. With machines of appropriate size an optimal effect is possible; economics, ecology</li> <li>10. Lower costs</li> <li>11. Safer work</li> <li>12. Less injuries, lesser impact on workers in working off the damage caused by natural disasters</li> <li>13. It does not produce invalids</li> <li>14. Work is possible almost under all weather conditions</li> </ol>
	<ol style="list-style-type: none"> <li>a) Technical criteria of use under various conditions in Slovenia</li> <li>b) Review statutory regulations</li> <li>c) Educate, inform well (experts, owners, contractors)</li> </ol>	

**Figure 4: Example of an H-form relating to the question "How do you assess the introduction of harvesting in Slovenia?" (Beguš 2002)**

The method is not only a useful participatory tool. It serves also as a good base for the analysis of the participants' opinions and consequentially the opinion of a certain group of people about a certain problem and it serves above all to analyze individual opinions and group orientation to discover negative and positive sides. The above described approach, based on this method has so far been used several times (Beguš 2002, Beguš 2008). The results of the analyses have served as additional base for professional and political measures.

### 3 Results of the comparison of both workshops – analysis of the development of attitude towards introduction of MC

The comparison of the results of both workshops shows in what direction the attitude towards the introduction of MC has been developing in Slovenia. The questions in both cases were practically the same but not to the extent which would enable statistical comparison. In 2002 we asked the participants: »How do you evaluate introduction of mechanized cutting in Slovenia?«, while in 2010 the question was »How do you evaluate the use of mechanized cutting in Slovenia so far?«. In 2002 participants did not have much knowledge about the problem and we expected a rather bad result while after eight years they gained certain experience and that is in fact what had formed their opinions. Therefore their answers were crucial for the improvement of the situation.

#### 3.1 Results of the analysis of H diagrams from 2001 and 2010

The comparison of the results of both workshops points to the fact that the scatter of individual estimations in 2002 was much bigger than in 2010 (Figure 5). The first workshop shows variations of estimations from total decline to absolute enthusiasm and their mean value is 5,39. This changes in 2010, the estimations vary from 3 to 8 with a deviation to the left, which means slightly negative, and their mean value is lower - 4,95. We cannot speak only about a negative attitude towards MC technology but also about negative experience (perhaps even unrealized expectations) with professional and political measures.

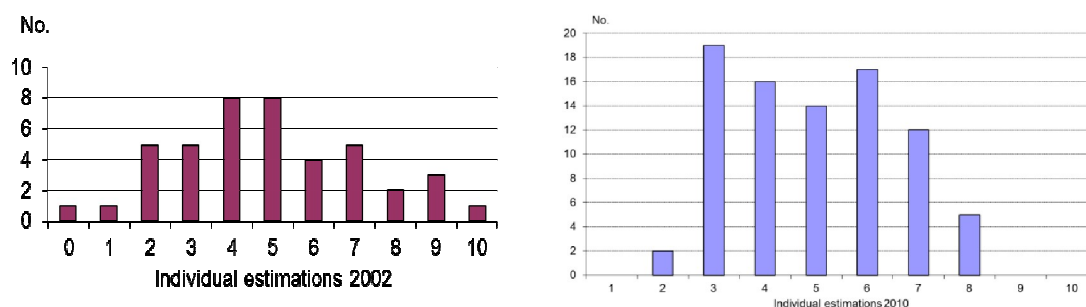


Figure 5: Comparison of individual estimations, 2002, 2010

In their answers to the question why their estimation had not been 10 in 2002 participants stated as main reasons declination from closeness-to-nature forest management, higher damage in the forest, lack of suitable sites in Slovenia for MC use, demanding work organization and lack of skilled staff. In 2010 the answers were: lack of knowledge and experience, lack of skills, damage in the forest, lack of professional basis, unsuitable mechanization, bad communication within forestry, high limitations for work condition, bad public attitude. In a certain sense, the answers were slightly similar. On the other hand, the answers to why not estimation 0 were equal at both workshops – all of them see as advantage higher rate of work humanization, higher efficiency and progress in the development of the profession.

Crucial for the process/participation are estimations of groups, estimations which were formed democratically and considered all the opinions in a certain group. Here we got somewhat different results. In 2002 the mean estimation of the groups was 4,83 while in 2010 it was 5,11. The first is lower than individual estimations and the second is higher with a smaller difference than the first one. This points to the fact that in 2010, individual estimations were based on more experience and knowledge and less emotions than in 2002.

#### 3.2 Directions and commitments of both workshops

In 2002 participants gave the following suggestions for the improvement:

⇒ Categorization of forests,

- ⇒ Determination of professional criteria,
- ⇒ Adequate selection (use) of mechanization,
- ⇒ Education,
- ⇒ Change of legislation,
- ⇒ Adjustment of silvicultural concept,
- ⇒ Adequate working technique.

We considered the directions of the first workshop and carried them out to a great extent. We made a map of possible MC (SFS and Bitechnical Faculty BF Department for forestry and renewable sources), SFS issued temporary instructions for work (Beguš 2009), legislation was improved in field of forest protection, SFS issued the Code of safe work, important work was done with respect of education of professional and other public, we carried out several press conferences, TV emissions, round tables, press releases where we emphasized the meaning of MC, cooperation between institutions and companies has developed, SFS made a strategy and instructions for communication with the media, under the patronage of BF we started to work on instruction of good practice, research institutions have made several studies in this area (Krč and Košir 2003), (Krč and Košir 2004), (Košir 2004a, Košir 2004b, Košir 2004c), (Mali and Košir 2007), (Krč 2006), (Krč 2007), (Košir and Mihelič 2011).

This (suggestions for the improvement) has changed in 2010, when the participants thought that the most important steps to improve the situation were the following:

- ⇒ Cooperation within the branch/profession,
- ⇒ Collective preparation of worksites,
- ⇒ To determine conditions for the performance of MC,
- ⇒ Education of professionals and public,
- ⇒ Gaining and exchange of practical experience,
- ⇒ Use of adequate machinery according to stand and technological conditions,
- ⇒ Standardization of the planning protocol, preparation, selection of technology and performance,
- ⇒ Adjustment of performance time/season,
- ⇒ Performance planning for cutting and skidding operation,
- ⇒ To create conditions for MC in private forests,
- ⇒ Communication with the public,
- ⇒ Through regulation determine conditions which restrict mechanized cutting,
- ⇒ Education of mechanized operators – include knowledge about tending and tree marking,
- ⇒ Associated forest owners for joint performance of MC (this is how MC shall develop).

Some suggestions are similar but interesting is the finding that without appropriately trained staff we cannot count on adequate working performance. In 2010 there was also a strong demand for professional determination of criteria for the use of MC which was the consequence of some bad experiences in the past. Let us mention the public which did not represent a problem in 2002 because the extent of MC was



small. With the growth of the use of MC the public is becoming critical especially when work is done unprofessionally and in inadequate conditions.

#### 4 Discussion

Introduction of MC in Slovenia has been planned and quite in time that its course was directed right (by our opinion) because otherwise it would become uncontrollable and would bring to conflicts and critical response of the public.

The way of introduction of MC was carefully designed and planned. This enabled a participatory approach and contribution of all stakeholders and thus made them respect the democratically obtained solutions.

Today professionals and the public see the problem of introduction of MC differently than ten years ago. In general, estimations obtained at workshops are slightly higher from those obtained in 2002, they are less emotionally loaded and are above all the result of experiences. The same goes for negative opinions which are also the result of experiences. These can be the consequence of interaction between individual actors in forestry – a typical case is their attitude because of different opinions about the quantity of allowable cut and the way of marking trees for cutting. They can also be due to bad performance of work using MC – big damage on the ground and stand. They can be the consequence of different comprehension of forest and its functions - perception of forest as an untouchable environment for recreation.

Opinions about positive results are close together. Quickly it was clear where the advantages of MC technology were and the experience only reaffirmed that. Thus MC has proven to be excellent for salvage cuts after storm damages. It is an important impulse for the profession and its development, not only in the area of forest operations but also in the area of silviculture and forest protection and forest management planning. It also represents a rich source of possibilities in the area of research and professional expertise which additionally improves the professional level of the branch.

In the process of participation and communication with the public the profession tried to establish an atmosphere which would lead to a democratic understanding and respect of different opinions. It is a constant process which cannot be neglected nor concluded with a reached consensus because new problems are appearing and will be appearing which will have to be resolved in this way.

It is important for the profession to focus on suggestions for the improvement of the situation and to take into account especially the results of the last workshop from 2010. Many suggestions are the same as from the workshop in 2002.

- ⇒ Let us point out education which participants of the first workshop ranked very high. At the last workshop education was precisely structured and several suggestions were made in that respect.
- ⇒ A lot of work will have to be done regarding adequacy of mechanization for individual development stages of the forest stands and individual soil types. Profession will have to be careful with this and obtain new knowledge and experience.
- ⇒ While suggestions of the first workshop were more or less a result of the first impression and low level of experience the last ones are based on concrete cases of work performance, relations within the branch and influences of the social environment. Therefore suggestions are concrete and are a result of needs which is well illustrated by the demand for determination of criteria for admissibility of MC and represents a big challenge for Slovenian forestry profession.
- ⇒ The demand for participation of the profession needs to be seriously considered. But not only for participation. An atmosphere of empathy needs to be established within the profession which will lead to understanding of the institutional, formal and organizational working environment of every stakeholder in the process of planning, preparation of work and performance of MC. Only a unified profession will be able to defend the decisions outwardly. A nice example of such

cooperation was a workshop in Pokljuka in 2009 where in front of members of the Slovenian Parliament we defended the use of MC after windbreaks.

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