Quality – a key to productivity in silvicultural services?

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1.1 Five dimensions to improve productivity

1.2 Main principles of quality management (e.g., Shewhart 1931, Juran 1951, Deming 1986, 1994, Juran & Gryna 1988, Gitlow 2001)

- Continuous improvement
  - PDCA-cycle (see Figure):
  - i.e. Hypothetic-deductive reasoning
- Systems thinking
  - Chains of actions/processes
  - Optimization of the whole chain, not single steps
- Statistical control of variation
  - Causes for variation
- Behavioural sciences
  - Support from leaders
  - No scapegoats, but poor systems
  - Teams/group work
  - Increase of autonomy, but also responsibility


1.3 However – depending on the activities the management for quality may not be so simple

(Lillrank 2003, Kankaanhuhta et al. 2009b)
2.1 Quality control inventories of forest regeneration


Scots pine direct seeding and Norway spruce planting:
- Forestry centres: 6
- Forest Owners’ associations (= FOAs): 39 – 41
- Forestry professionals: 228 – 284
- Municipalities: 112 – 119
- Stands: 2447 – 4879
- Sample plots: 39523 – 77,989

2.2 Norway spruce planting

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Proportion, % (-/+)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept (planted s.)</td>
<td>1366 ***</td>
<td></td>
</tr>
<tr>
<td>Stony soil</td>
<td>-28 ***</td>
<td></td>
</tr>
<tr>
<td>Wet soil</td>
<td>-27 ***</td>
<td></td>
</tr>
<tr>
<td>Site type (*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OMaT or OMT</td>
<td>-3 ***</td>
<td></td>
</tr>
<tr>
<td>VT or CT or Clt</td>
<td>-2 *</td>
<td></td>
</tr>
<tr>
<td>Soil preparation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No preparation</td>
<td>-20 ***</td>
<td></td>
</tr>
<tr>
<td>Disc trenching</td>
<td>1 ns</td>
<td></td>
</tr>
<tr>
<td>Mounding</td>
<td>9 ***</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>7 ns</td>
<td></td>
</tr>
<tr>
<td>Soil texture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse mineral</td>
<td>-1 ns</td>
<td></td>
</tr>
<tr>
<td>Fine mineral</td>
<td>-4 ***</td>
<td></td>
</tr>
<tr>
<td>Peat</td>
<td>-10 ***</td>
<td></td>
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</tbody>
</table>

"Planted s." = Planted seedlings/ha
2.3 Scots pine direct seeding

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Proportion, %</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept (S.p. seedl.)</td>
<td>2531</td>
<td>***</td>
</tr>
<tr>
<td>Stony soil</td>
<td>-32</td>
<td>***</td>
</tr>
<tr>
<td>Wet soil</td>
<td>-31</td>
<td>***</td>
</tr>
<tr>
<td>Site type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OMaT or OMT</td>
<td>-39</td>
<td>***</td>
</tr>
<tr>
<td>VT</td>
<td>33</td>
<td>***</td>
</tr>
<tr>
<td>CT or CIT</td>
<td>43</td>
<td>***</td>
</tr>
<tr>
<td>Soil preparation</td>
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<td></td>
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<tr>
<td>No preparation</td>
<td>-44</td>
<td>***</td>
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<tr>
<td>Patching</td>
<td>2</td>
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<tr>
<td>Mounding</td>
<td>9</td>
<td>*</td>
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<tr>
<td>Other</td>
<td>-3</td>
<td>ns</td>
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<tr>
<td>Soil texture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse mineral</td>
<td>5</td>
<td>**</td>
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<tr>
<td>Fine mineral</td>
<td>-15</td>
<td>***</td>
</tr>
<tr>
<td>Peat</td>
<td>-15</td>
<td>***</td>
</tr>
<tr>
<td>Sowing method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual: seed quantity</td>
<td>-14</td>
<td>***</td>
</tr>
</tbody>
</table>

“S.p. seedl.” = Scots pine seedlings/ha

3 Cost–quality relationship of forest regeneration – considerable variation

- Norway spruce planting:
  - By paying 100 € a forest owner was able to buy 33 crop-trees/ha (mean = 1522 seedlings/ha).
  - Demanding site conditions (fertility, soil texture) were not taken into account in implementation (costs) in either of the regeneration chains.

- Scots pine direct seeding:
  - By paying 100 € a forest owner was able to obtain 6.5 Scots pine seedlings/ha (mean = 1707 seedlings/ha).
  - However, on Myrtillus type and more fertile ones as well as on fine-textured soil the regeneration result decreased considerably.

4.1 Conceptual modelling of silvicultural service processes

- One framework, how to plan, control and improve forest regeneration processes.
- Starting point:
  - conceptual analysis of the actions and classification of them to standardized, routine and non-routine processes according to the following phases:

  ![Conceptual Modelling Diagram]

  - After the conceptual models also more quantitative and dynamic models are possible.

4.2 Conceptual modelling of forest regeneration activities

- Are the right things done right?
  - The planned production system is under control, and it is predictable to some extent.
- Are the right things done wrong?
  - Variation from the common/system causes and special causes, which have to be found.
- Are the wrong things done right?
  - For example, the selection of target/regeneration chain was wrong or the selection of soil preparation method was wrong, but the operations were carried out right.
- Are the wrong things done wrong?
  - Both errors in selections of methods and defects in the execution of operations occurred.
5.1 The effect of quality management interventions

- The most common reasons found for poor regeneration results by the forestry professionals in feedback events after the quality control inventories were (according to the mail survey):
  - wrong type of soil preparation method of Norway spruce,
  - artificial regeneration of Scots pine on too fertile sites,
  - too low soil preparation and planting densities, and
  - too small seedling type of Norway spruce.

- The reasons for obtained inventory results and the set objectives by the participated forestry professionals were mainly consistent with the changes in forest regeneration activities. However, there were indications of difficulties in implementing common level knowledge into practices, e.g.
  - the visits to check site conditions to ascertain proper selection of further operations, as well as
  - the adopted rate of self-control measurements (of soil preparation and planting density).


5.2 The effect of quality management interventions

- Soil preparation:
  - The number of excavator contractors had increased 16% more among quality-work participant forestry professionals
  - The contractors had acquired 23% more soil preparation equipment in the participant FOAs.
  - Patch mounding had increased most in the context of Norway spruce planting.

- Choice of regeneration material:
  - The seedlings older than 1.5 years were used in the planting of Norway spruce 11% more in the participant FOAs, and the usage of two-year-old seedlings had increased 11% also more.

- Education and feedback systems:
  - The planting workers had visited 14% more education events and self-control measurements of soil preparation and planting density were adopted 10% more in the participant FOAs.
  - The interest in obtaining feedback by means of using quality control inventories was more common in the participant FOAs.
5.3 Forestry statistics in the area of six quality-work-participant forestry centres

- Regeneration methods:
  - “S.p. dir. seed.” = Direct seeding of Scots pine
  - “Other dir. s.” = Direct seeding of other tree species
  - “S.p. planting” = Planting of Scots pine
  - “N.s. planting” = Planting of Norway spruce
  - “Other pl.” = Planting of other tree species

- Soil preparation methods:
  - Disc trenching
  - Mounding


6.1 Self-control measurements of soil preparation, planting, and direct seeding

Number of planting spots in soil preparation
Quality of mounds/patches
Area without soil preparation or planting

Self-control of mechanized planting (number of seedlings)
Quality control of mechanized direct seeding

Examples of forms in Finnish:
http://www.metla.fi/metinfo/metsanhoitopalvelut/omavalvonta_manuaali.htm
6.2 Self-control measurements as a part of development of pre-commercial thinning services

- Feedback for quality work
- Updates for forest information syst.
- Pricing and timing information
- Cost-efficiency through ICT

Kiitos

Thank You!

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