Regional Network projects as a way to introduce innovation to SMEs
Experience from Norwegian programs

POLISH NORWEGIAN COOPERATION
FOR ENVIRONMENTAL FRIENDLY
AND INNOVATIVE SOLUTIONS
IN SMES - POLNORECO

Leif Anders Estensen, 28th of November 2017
Knowledge transfer, networking and innovation

November 2017

Leif Anders Estensen

NTNU Department for Mechanical Engineering and Production

leif.a.estensen@ntnu.no
+47 930 58 759
Contents

- NTNU
- Competence brokering in single company
- Competence brokering and innovation in network
- Experience and results
- Case studies/examples

Active participation and the same understanding
Foto: Solveig Svardal, Telemarksforsking
This is also Norway

Plus 25 degrees Celsius

Minus 25 degrees Celsius

Foto: Vidar Heitkøtter (www.gd.no)
This is Trondheim
NTNU
Norwegian University of Science and Technology
Trondheim, Norway

- 9 faculties and 56 departments with a broad selection of programmes and disciplines
- 6700 employees, of which 4053 are in teaching and research
- 40 % are female
- Approx. 39,000 students, of which 3,000 are from abroad
- 44-45 % are female
- Employees and students from more than 90 countries
- 340 – 375 PhD doctoral degrees yearly, of which 41 % are by international students
- Close cooperation with SINTEF (2000 employees) and St. Olavs Hospital, and others
- Cooperate with more the 200 other universities
- www.ntnu.no
Use of students from the University in project work

Biology students at field work
Photo: Kim Nygård, NTNU

Department of Building and Environment Technology
Photo: Arild Juul, NTNU

Students develop and build cars
Photo: Leif Estensen, NTNU

Students develop and build new bicycles
Photo: Rune Petter Ness, NTNU
The students work on specific projects and learn team work.
Many different disciplines and groups
Partnership between NTNU and SINTEF is strategic and operative

Common use of laboratories and equipment

NTNU-staff work on SINTEF-projects

SINTEF-staff teach at NTNU

50 %

“The industrial ring”

Collaboration NTNU - SINTEF has been developed through 60 years
Knowledge transfer to companies participating in a single project or in innovation networks

Competence => Knowledge + Experience

Experience from Norway

- Knowledge transfer to single company
- Competence transfer and innovation in network
- Experience, results and effects
- Case studies and examples
History of Knowledge Transfer in Norway

1977- Meeting places
1982-1984
Regional Pilot
Norway-Sweden
1984-1988
Pilot in one
Norwegian county

1989-1993
DTS-programme
9 of 19 counties
9 brokers
2135 SMEs
1011 projects

1994-2003
TEFT-programme
Nationwide
12 brokers
3732 SMEs
1560 projects

2004-2006
R&D-based
brokering
25-35 brokers

2007-2016
VRI-programme
More SMEs
and business
sectors
> 50 brokers
Experience from 4 counties in Norway

The primary goal has been to encourage innovation, knowledge development, technology transfer and strengthen the R&D effort in SMEs.
Competence brokering and knowledge transfer to single company (face to face project)

The broker connects SME and R&D

"Barriers"

The scientist explains technology to the company when a student is watching. Active participation and the same understanding
R&D based brokering and project development

The way from idea to project start

Company → Project-idea → Company → Project-proposal → OK → Approval → Project START

Follow-up

Pre-project report

Broker

Broker and Scientist

Scientist

Company

Broker
Overview Companies

Plan for Company Visit

Complete Company Visit
Identify Challenges and Needs

Describe Challenges
Propose Project

Clarify with
Univ./R&D

Draft Project Proposal

Clarify with
Company

Final Project Proposal
Pre Project Report
Assignment Letter

Contracts
Distribute Documents
Implement Project

Follow up Implementation of the Project

Clarify with Innovation Norway

Feedback to Company
Communicate and Refer to Other

Clarify with Innovation Norway

Terminate Project
Continuance

Final report
Financial Settlement
Project Termination

Different Foundlings

Develop new Project Proposal
Develop Application

Implement new
Continue Project

Leif Estensen
2016-08-25
Research based competence brokering

The money flow

University/R&D/The scientist

Program

Company

The motivation is build in this mechanism due the fact that

- The scientists are the receiver of the money
- 100 % of the total financing is paid after the project is finished
The competence broker

- Be a link between companies and Universities/R&D
- Have a good overview over
  - The SMEs and businesses in the region where working
  - The knowledge and contact persons at Universities and R&D-institutes
  - The political instruments for financing
- Have professional and personal qualifications and characteristics seen in the light of the target group (businesses and companies)
- Be able to speak “two languages”
- Be proactive and willing to travel and visit many companies
- Background from university/R&D-institute, and experience as researcher
Core business for the competence broker

- Map, select, and visit companies (SMEs)
- Clarify and identify R&D challenges, needs and possibilities
- Establish contact with relevant University, R&D-institution or other parties matching the challenges
- Develop proposal, plan, and initiate company specific projects
- Follow-up and conclude projects

- Cooperate with regional parties for innovation projects
- Cooperate with the regional public support system for signposting and additional support
- Provide contacts and competence through national and international networks (EEN)

www.elmico.no  www.rorsystemer.no  www.treski.no
Experience and results from region Innlandet
Hedmark county and Oppland county

- 50-60 companies are visited yearly
- About 55-60% of the company visits are based on initiative of the competence broker
- Other contacts
  - More and more companies take contact themselves
  - Suggestions from public regional administrations
  - Researchers and even students give input
- More than 300 projects in the last 12 years
Number and type of industry and projects
Experience from Region Innlandet

Type of industry related to the number of projects

- Wood
- Mechanical
- Food
- Plastic
- Environment
- Founders
- Construction
- Culture
- Other

Number of type of projects

- Product development
- Process development
- Specific competence
- Technology strategy
- Market development
30 % of 316 projects are in the woodworking industry. Product (48 %) and process development (41 %)
27% of 316 projects in mechanical, and 12% in food industry. Only 9 projects in SMEs with more than 100 employees.
Concluding remarks

Competence transfer to single companies

- Effects (case interview after ended project)
  - Change in attitude regarding cooperating with Universities/R&D
  - Valuable input of knowledge to the company
  - Solving company relevant problems with external knowledge gives rapid and better results
  - Mostly small projects
  - Use of students in the projects are valuable and inexpensive
  - Possibility to recruit and employ educated students
  - The broker is important in project development and finding the right knowledge

- Master studies by students (in-depth interviews of companies in 2015)
  - There are clear differences between the companies (Yes and No Companies)
  - Education and background affect the basis for collaboration with Universities/R&D
  - Interaction and good communication (face-to-face) affect the collaboration
  - Relations and in-house knowledge are important
  - An active board with external members initiate the “best projects”
  - Attitude and capability to absorb, use and manage the knowledge is vital
  - Use of students are highly welcome
Bring companies and researches together for innovation
Concept of Innovation in Network

Competence brokering, teamwork and knowledge management between more companies, Univ./R&D and policy instruments

Companies

Networking and Innovation Projects

Universities, R&D and knowledge communities

Innovation Norway
Innovation in Network

- Business development
- Innovation
- Technology projects
- Networking
- Co-operation
- Competence upgrading
- Internationalization
- Continuing projects

Leif Estensen, NTNU-IPK, Norway, MAY 2016
IDÉSØK10 – Innlandet 2014-2015

- Bedriftsutvikling og innovasjon
- Teknologi- og utviklingsprosjekter
- Nettverksbygging
- Samarbeid
- Kompetanseoppbygging
- Internasjonalisering
- Videreføringsprosjekter
The project model

Phase 1: Recruitment
Phase 2: Challenges and needs. Situation analyses
Phase 3: Initiation of actions and innovation projects
Phase 4: 6 workshops

Step 1: Innovation Projects
Step 2: Other projects

Marked introductions and commercialization
Continuing projects

Leif Estensen, NTNU-IPK, Norway, MAY 2016
Presentation and discussion in groups
Special theme at each workshop
“Visit and guided tour in RobotLab”
Group of students in company specific projects
From the Hydropower Department at NTNU
Trainees from colleges

Lack of CNC operators in Norway
Concluding remarks
Knowledge transfer to SMEs in Network

- Each company has their own mentor (researcher, professor, etc.) for the whole project period
- The creative environment in networks introduces many new ideas and innovative projects (3 to 6 projects in each SME)
- Mostly big projects
- Established networks last several years
- Use of R&D knowledge for solving specific challenges
- Use of students as trainees, in bachelor and master's theses/projects
- Increased knowledge in the SME’s, and also in the institutes
The knowledge creation model

Source: Nonaka and Takeuchi (1995)
Localization of the project in Poland

Targeted industries

Industrial processing
- Food
- Fruits/vegetables
- Wood/furniture
- Mechanical
- Public/private health facilities
Company visits in Bialystok
Company visits in Lublin
Polish companies visit Norwegian companies
Sandvik Teeness AS 17. November 2016
Concluding remarks

- Knowledge transfer between two countries generates both opportunities and challenges
- Several cultural factors can affect the knowledge transferring process
- Challenges regarding languages
- Need time to develop and strengthen trust
- Strong focus on creating a common ground of understanding
- Exchange of experience on more levels:
  - Institutional in both countries
  - Between the companies
  - Between the experts involved in the project
  - In the organization of support systems for SMEs
- Use of students are highly welcome
Aspects that characterize Norwegian SMEs

- Short distance between employees and management
- Employees who largely take responsibility
- Well educated people and high competence
- Use of students in the project work are valuable and inexpensive
- Culture for collaboration within the company - and also between companies
- Strong focus on sharing knowledge and experience
- There are very many SMEs in the Norwegian production industry
- Advisory board with external members
- High labor costs
- Great focus on automation and efficiency
- High IT competence in the Norwegian population
“The researcher's afternoon and evening at NTNU”
“Those who use ipad in early age benefit from it. They are better prepared for adulthood than the parents were”

Trygve Lundemo
www.adressa.no

Trends for the future
- Young people and IT
- Technological innovations
- More and more information
- Knowledge explosion
- Digitalization
- Network society
- Globalization
- And so on

Illustration: Karl Gundersen
Labor cost per hour for industrial workers
Norwegian NOK in 2011

*Dette koster én ansatt i én time
Gjennomsnittlige lønnskostnader* pr. time for industriarbeidere. 2011.

Kroner pr. time

<table>
<thead>
<tr>
<th>Country</th>
<th>Kroner pr. time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norge</td>
<td>308</td>
</tr>
<tr>
<td>Danmark</td>
<td>265</td>
</tr>
<tr>
<td>Belgia</td>
<td>255</td>
</tr>
<tr>
<td>Nederland</td>
<td>227</td>
</tr>
<tr>
<td>Østerrike</td>
<td>221</td>
</tr>
<tr>
<td>Sverige</td>
<td>221</td>
</tr>
<tr>
<td>Finland</td>
<td>208</td>
</tr>
<tr>
<td>Tyskland</td>
<td>203</td>
</tr>
<tr>
<td>Frankrike</td>
<td>184</td>
</tr>
<tr>
<td>Italia</td>
<td>176</td>
</tr>
<tr>
<td>Irland</td>
<td>169</td>
</tr>
<tr>
<td>Storbritannia</td>
<td>140</td>
</tr>
<tr>
<td>Spania</td>
<td>135</td>
</tr>
<tr>
<td>Tsjekkia</td>
<td>62</td>
</tr>
<tr>
<td>Polen</td>
<td>38</td>
</tr>
</tbody>
</table>

*Tar hensyn til forskjeller i sykefravær, lengden på ferien, arbeidsgiveravgift og andre kostnader knyttet til arbeidsforholdet.

Kilde: Teknisk beregningsutvalg for inntektsoppgjørene
© Aftenposten grafikk
Automation and efficiency in production
Process development and automation
Analysis of 117 projects

<table>
<thead>
<tr>
<th>Type</th>
<th>Classification of projects</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>New concept – new process</td>
<td>24</td>
</tr>
<tr>
<td>B</td>
<td>General automation and efficiency</td>
<td>18</td>
</tr>
<tr>
<td>C</td>
<td>Automation analysis/robotics</td>
<td>14</td>
</tr>
<tr>
<td>D</td>
<td>Logistics/material flow</td>
<td>10</td>
</tr>
<tr>
<td>E</td>
<td>Machining</td>
<td>10</td>
</tr>
<tr>
<td>F</td>
<td>Maintenance</td>
<td>9</td>
</tr>
<tr>
<td>G</td>
<td>Continuous improvement with 5S</td>
<td>9</td>
</tr>
<tr>
<td>H</td>
<td>Production planning and management</td>
<td>6</td>
</tr>
</tbody>
</table>
“Analysis of the potential for automation”
Process and product development

“Gluing of complex wood constructions”
Typical project within the food industry
Cycle time for products in the workshop

Results from surveys in 1980

Machine time (5 %)

30 % 70 %

Machining

Clamping, correct, measurement, etc.

Transport, storing, waiting (95 %)

5 %

Transport og lagring 95 %

LeanLab for training
“Processing of reindeer lichen/moss and development of new products”
“Evaluation of an idea”
Concluding remarks

A national study in Norway

- 94% of the participated SMEs would like to cooperate with Universities and R&D institutes again

- 92% of the participated scientists would like to cooperate with SMEs again
Thank you for your attention

Nice places for skiing

Norwegian mountain trout

Chanterelle mushrooms

Cloudberries
The Production Process and The Hidden Factory

- Ideas → Needs
- Product development Design

- What
  - Product Spec.

- How
  - Technology planning
  - Production Spec.

- Demands
  - MRP
  - Internal orders

Raw materials → Production → Finish products

- How much
- When
# WASTE IN THE FACTORY

<table>
<thead>
<tr>
<th></th>
<th>Examples of waste</th>
<th>Definition/or the question is</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overproduction</td>
<td>Is it necessary to spend time to produce more than you can sell?</td>
</tr>
<tr>
<td>2</td>
<td>Storing</td>
<td>How much do you really need to have in stock? Remember that goods in stock is a cost driver.</td>
</tr>
<tr>
<td>3</td>
<td>Transportation</td>
<td>How much time is spent on internal transport? (Materials, parts, products, people, etc.?</td>
</tr>
<tr>
<td>4</td>
<td>Over-processing</td>
<td>Is it necessary that the chassis under your car is shiny?</td>
</tr>
<tr>
<td>5</td>
<td>Waiting</td>
<td>How much time is spent on waiting?</td>
</tr>
<tr>
<td>6</td>
<td>Unnecessary movements</td>
<td>It is used unnecessarily much time to move around? Where are things located?</td>
</tr>
<tr>
<td>7</td>
<td>Rework</td>
<td>How much time is spent on correcting mistakes and errors? (Defects, rejects and scrap)</td>
</tr>
<tr>
<td>8</td>
<td>Unused creativity</td>
<td>Are the human resources adequately utilized?</td>
</tr>
</tbody>
</table>
Sortowanie

Samo-
dyscyplina

Systematyka

Standaryzacja

Sprzętaine

5S

Source: Olga and Marta
OEE – Overall Equipment Efficiency

A measurement parameter used to monitor and improve the efficiency of manufacturing processes.

- **Availability**
  - Setup time
  - Waiting
  - Failure with equipment

- **Performance**
  - Reduced speed
  - Idle time
  - Small stops

- **Quality**
  - Corrections
  - Rework
  - Scrap

---

Analysis of process loss indicators (PLI)
Efforts to increase the OEE
# The OEE-Model

## Total operation time

<table>
<thead>
<tr>
<th>Availability</th>
<th>Performance</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Potential production time</td>
<td>C: Theoretical output</td>
<td>E: Actual output</td>
</tr>
<tr>
<td>B: Actual production time</td>
<td>D: Actual output</td>
<td>F: Good product</td>
</tr>
</tbody>
</table>

### Availability
- **A**: Potential production time
- **B**: Actual production time
- **No production scheduled**
  - Availability losses, like breakdowns, waiting, changeover

### Performance
- **C**: Theoretical output
- **D**: Actual output
  - Performance losses, like minor stops, reduced speed

### Quality
- **E**: Actual output
- **F**: Good product
  - Quality losses like scrap, rework, corrections etc.

### Calculation

\[
\text{OEE} = \frac{B}{A} \times \frac{D}{C} \times \frac{F}{E}
\]

\[
\text{OEE} = \text{Availability rate} \times \text{Performance rate} \times \text{Quality rate}
\]
OEE – Overall Equipment Efficiency

A standard measure for reporting business performance to management and business owners

**Example:** Manufacturing Company’s plant is scheduled to operate for 16 hours (960 minutes) per day, 5 days a week, 50 weeks per year. Last year, the plant produced an average of 480 units per day, of which 460 met the quality specifications. The plant had on average of one product changeover per day, lasting 30 minutes, and experienced an average of 100 minutes per day of unplanned downtime. The plant was designed to produce 40 units per hour. Daily theoretical output = 40 x 16 = 640 units

**Availability:** Scheduled Time = 960 minutes per day. Available Time = 960 minutes scheduled minus (100 minutes unscheduled downtime + 30 minutes’ changeover) = 830 minutes/day. Availability = 830 available minutes/960 scheduled minutes = 0,865

**Performance:** Actual output/theoretical output = 460 units/640 units = 0,750

**Quality:** 460 good units/480 produced units = 0,958

**OEE** = Availability x Performance x Quality = 0,865 x 0,750 x 0,958 = 0,622 => **62,2 %**

Toyota has the highest OEE output in the world, with an OEE-factor at 90 %. In Europa OEE average was around 42 % in the early 2000s.

Normally, less than an OEE at 65 % should be considered unacceptabile, since it represents a very low competitiveness and a great number of economic losses (PLI)
Music and football are “communication languages”

https://www.youtube.com/watch?v=bAdqazixuRY

https://www.youtube.com/watch?v=Es3Vsfzdr14
Mechanical industry
Processing and preventive maintenance
Competence for advanced machining
Modelling and foundry techniques
Megatrends are important, however the development is not linear. Many basic conditions changing faster than these megatrends.

Some earlier example of predictions for the future:

- Aircrafts heavier than air is impossible (Lord Kelvin, president Royal Society, U.K. 1895)
- Stock prices seem to have reached a permanent high level (Irving Fisher, economy professor at Yale, 1929)
- I think there is a world market for maybe five computers (Thomas Watson, President at IBM, 1943)
- We do not like their sound, and moreover guitar music is on the way out (Decca Recording Co about the Beatles, who was dismissed in 1962)
- The Wall will still be there in 50 years, yes, even in 100 years (Erich Honnecker, DDR in February 1989)
Aspects that characterize Polish SMEs in the project

- Centralised management style – most of the companies in the project have one or two owners which are also responsible for daily management
- Companies are also in relevant part family companies where at least to generations are involved in daily operation
- Small culture for external cooperation
- The business culture is low trust culture, which is also the result of the historical set up
- Approach towards sharing knowledge and learning is initially reluctant. It takes time to build up the trust and convince the participants that delivered knowledge may be relevant and useful
- There is a strong and visible difference in approach towards learning and sharing between young (up to 45) generation and older managers, who are rather reluctant to change
- No practice of hiring external advisory board members
- Low labour costs, especially in Eastern regions
Thank you for your attention

Nice places to go skiing

Norwegian mountain trout

Chanterelle mushrooms

Cloudberries