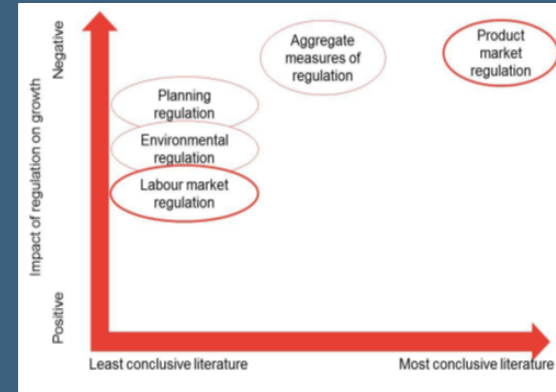


Jean Claude Juncker:

□ *New boost for jobs, growth and investment: It has been recognized that Europe must not stifle innovation and competitiveness with too prescriptive and detailed regulations, notably when it comes to SMEs.*



Source: Frontier Economics

- Increasing the administrative costs of market entry can have a significant negative impact on productivity growth
- A reduction in product market regulation has a positive impact on competition which increases innovation and therefore productivity

“Significant resource transferred from innovation to administration to prepare DoPs”
 CPR hearing comment from unnamed manufacturer.

Certification – experience show it is necessary

But quality comes with a cost...



- + Geotextile use in Finland, Sweden and Norway is widespread
- + Quality certification by 3rd party increase customer confidence
- + Prototype certification
- + On-site testing on random basis
- + Consequences if a product fails in prototype- or on-site test
- + Higher prices on quality marked products

- Joint and several cost distribution (no incentive to focus on quality)
- Branding of NGS as quality mark

Classification can not replace good design

Separation / filtration design – not a simple discipline

LESSON LEARNED from this successful method

What started as **technology transfer**
from geotechnical engineering to geosynthetics engineering
ended as **technology transfer**
from geosynthetics engineering to geotechnical engineering.

Geosynthetics engineering
is a new discipline
with innovative research that can
benefit a mature discipline
such as geotechnical engineering.

Filtration – more than 20 design criterias

- General acceptance that the soil must be included in the design

Issues (Koerner):

- Steady flow / reversing flow situations
- Thick / thin geotextiles (Surface / in-depth filtration)
- Cohesionless fine grained silts
- Cohesionless gap-graded sandy silts
- Dispersive clays
- Ochre forming soils
- Lack of intimate contact between soil and geotextile
-
-

Table 1. Existing geotextile filter criteria (after Fischer, et al., 1990).

Source	Criterion	Remarks
Calhoun (1972)	$O_{60}/D_{15} \leq 1$ $O_{60} \leq 0.2 \text{ mm}$	Wovens, soils with $\leq 50\%$ passing #200 sieve Wovens, cohesive soils
Zitscher, 1975 (from Rankilor, 1981)	$O_{90}/D_{50} \leq 1.7-2.7$ $O_{90}/D_{50} \leq 25-37$	Wovens, soils with $C_u \leq 2$, $D_{50} = .1$ to $.2 \text{ mm}$ Nonwoven, cohesive soils
Ogink (1975)	$O_{60}/D_{60} \leq 1$ $O_{60}/D_{60} \leq 1.8$	Wovens Nonwovens
Sweetland (1977)	$O_{15}/D_{15} \leq 1$ $O_{15}/D_{15} \leq 1$	Nonwovens, soils with $C_u = 1.5$ Nonwovens, soils with $C_u = 4$
Rankilor (1981)	$O_{60}/D_{15} \leq 1$ $O_{10}/D_{15} \leq 1$	Nonwovens, soils with $0.02 \leq D_{15} \leq 0.25 \text{ mm}$ Nonwovens, soils with $D_{15} > 0.25 \text{ mm}$
Schober and Teindl (1979) with no factor of safety	$O_{60}/D_{50} \leq 2.5-4.5$ $O_{60}/D_{50} \leq 4.5-7.5$	Woven & thin nonwovens, dependent on C_u Thick nonwovens, dependent on C_u , silt and sand soils
Millar, Ho and Turnbull (1980)	$O_{60}/D_{15} \leq 1$	Wovens and nonwovens
Giroud (1982)	$O_{60}/D_{50} \leq (9-18)/C_u$	Dependent on soil C_u and density; assumes fines in soil migrate for large C_u
Carroll (1983)	$O_{60}/D_{15} \leq 2-3$	Wovens and nonwovens
Christopher and Holtz (1985)	$O_{60}/D_{15} \leq 1-2$ $O_{10}/D_{15} \leq 1$ or $O_{60}/D_{10} \leq 0.5$	Dependent on soil type and C_u ; dynamic, pulsating & cyclic flow, if soil can move beneath fabric
French Committee on Geotextiles and Geomembranes (1986)	$O_1/D_{15} \leq 0.38-1.25$	Dependent on soil type, compaction, hydraulic & application conditions
Fischer, Christopher and Holtz (1990)	$O_{60}/D_{15} \leq 0.8$ $O_{60}/D_{15} \leq 1.8-7.0$ $O_{60}/D_{50} \leq 0.8-2.0$	Based on geotextile pore size distribution, dependent on C_u of soil

Therefore,
a geotextile filter is **safer**
if it is designed with
the retention criterion
that **takes into account**
the **internal stability**
of the soil.

The same can be done
with granular filters.

NGS is OK for most cases

- but it is conservative and does not support innovation

Subsoil:

The subsoil is divided into two groups, Soft and Firm; these groups can be categorised according to soil type and shear strength:

- Soft – soft clay with undrained shear strength ≤ 25 kPa, and peat.
- Firm – medium and stiff clay with undrained shear strength > 25 kPa, and sand and gravel.

Table 2: Selection of relevant specification profile

SUBSOIL	CONSTRUCTION CONDITIONS	TRAFFIC	MAXIMUM GRAIN SIZE (D_{MAX}) IN FILL MATERIAL (MM)			
			$d_{max} < 63$	$63 < d_{max} < 200$	$200 < d_{max} < 500$	$d_{max} > 500$
Soft	Normal	High	3	4	5	5
		Normal	3	4	4	5
	Favourable	High	3	3	--	--
		Normal	2	3		
Firm	Normal	High	2	3	3	4
		Normal	2	2	3	3
	Favourable	High	2	2	--	--
		Normal	2 ¹⁾	2		

Optimize energy index at lowest possible weight!

- and don't mind the separation/filtration?

Function: separation and filtration							
CHARACTERISTIC	UNIT	MAXIMUM TOLERANCE ¹⁾	REQUIRED ²⁾ VALUES CORRESPONDING TO 95% CONFIDENCE LIMIT				
			SPECIFICATION PROFILES				
			1	2	3	4	5
Min. tensile strength	kN/m	-10 %	6	10	15	20	26
Min. tensile strain at max. load	%	-20 %	15	20	25	30	35
Max. cone drop diameter	mm	+25 %	42	36	27	21	12
Min. energy index	kN/m		1.2	2.1	3.2	4.5	6.5
Min. velocity index	10 ⁻³ m/s	-30 %	3	3	3	3	3
Max. char. Opening size, Ogo	mm	±30 %	0.2	0.2	0.2	0.15	0.15
Max. tolerance for mass per unit area			±12 %	±12 %	±10 %	±10 %	±10 %
Max. tolerance for static puncture strength			-10 %				

Just as important....

- **Most failures are caused by poor design or damage during installation!**
- **Inspection of incoming goods (is packaging OK, rolls undamaged etc.)**
- **Installation details – who to call if in doubt?**

Customer service is a valuable part of Quality!

Classification – a perspective...

Scandinavian internet tender 2016:

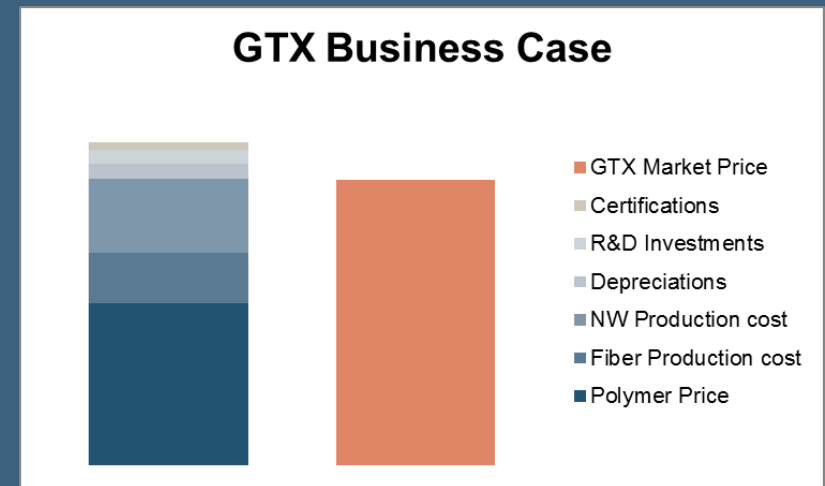
- Specification: NGS classes 2, 3 and 4
- Preferably white color (!)
- Criteria: Lowest price

Would You invest in GTX production in Scandinavia?

No room for innovation!

Little room for maintenance (= depreciations)

Reduced focus on quality (no premium)



Summary

- **Certification is great to ensure customers get good quality.**
- **Certifications should go hand-in-hand with on-site testing.**
- **Quality and costs should be inversely proportional!**
- **Classification is suitable to industrial module components. It does not bring quality into geotechnical engineering.**
- **Most failures are related to damage during installation and poor design. Services like packaging, design service, installation guidelines etc. are not appreciated in the NGS.**
- **Geotextiles have become a commodity in NGS markets to a point where quality and innovation is compromised.**

Thank you!

Questions and comments?