DANIELI WEAN UNITED

MMMM 2011 CONFERENCE, NEW DELHI

Thin Slab Casting & Rolling technology for hot rolled coil production - Danieli's innovative concepts and experiences

SESSION IV
February 13, 2011
14.30 – 18.00 Hours

Sanat K BHAUMIK, Danieli India Limited.

Thin Slab Casting Rolling: the beginning

First generation of Thin Slab Caster & Rolling

↓

Reduced investment and transformation cost
Target: commercial products segment

↓

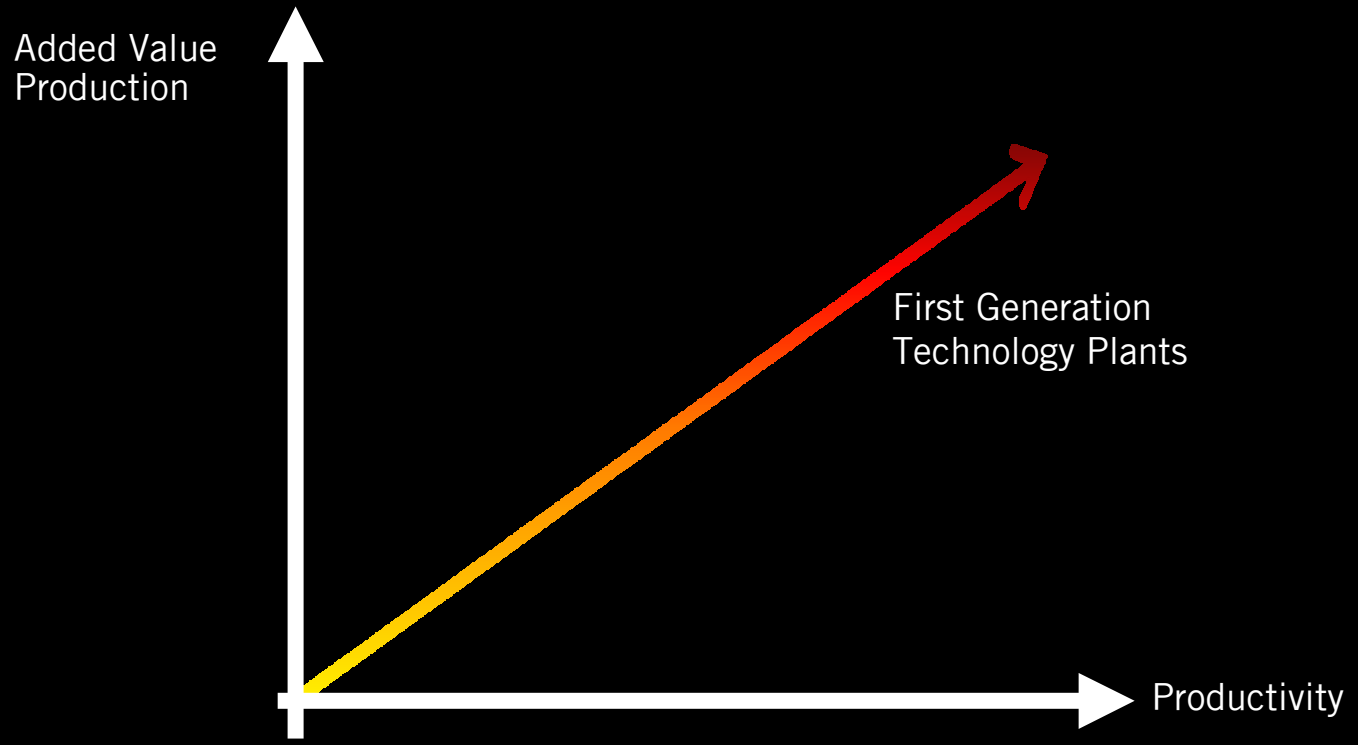
Drawbacks of applied technology in “first generation plants”

- Limitation in product mix & steel grades
- Limitation in production
- Commercial quality

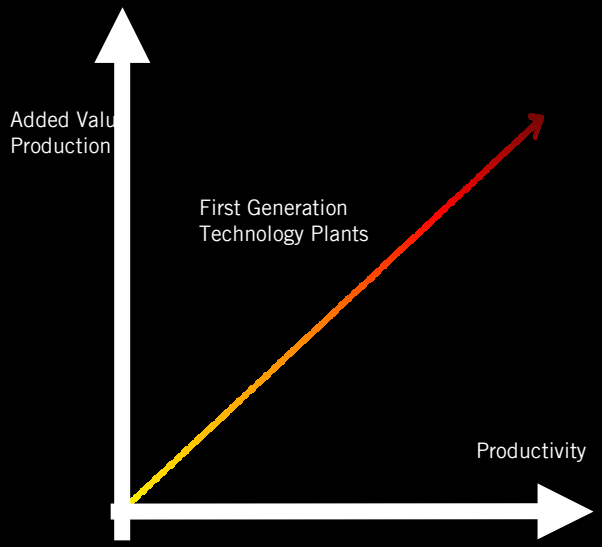
Statement

Considering present market status trends, a flat products minimill conceived to target commercial quality market, with limited productivity (below 1.5 / 1.6mtpy), as given by “first generation technology”, is not economically sustainable.

Thin Slab Casting Rolling: the evolution



Thin Slab Casting Rolling: the evolution



Danieli minimill concept:
the new generation of minimill for flat products

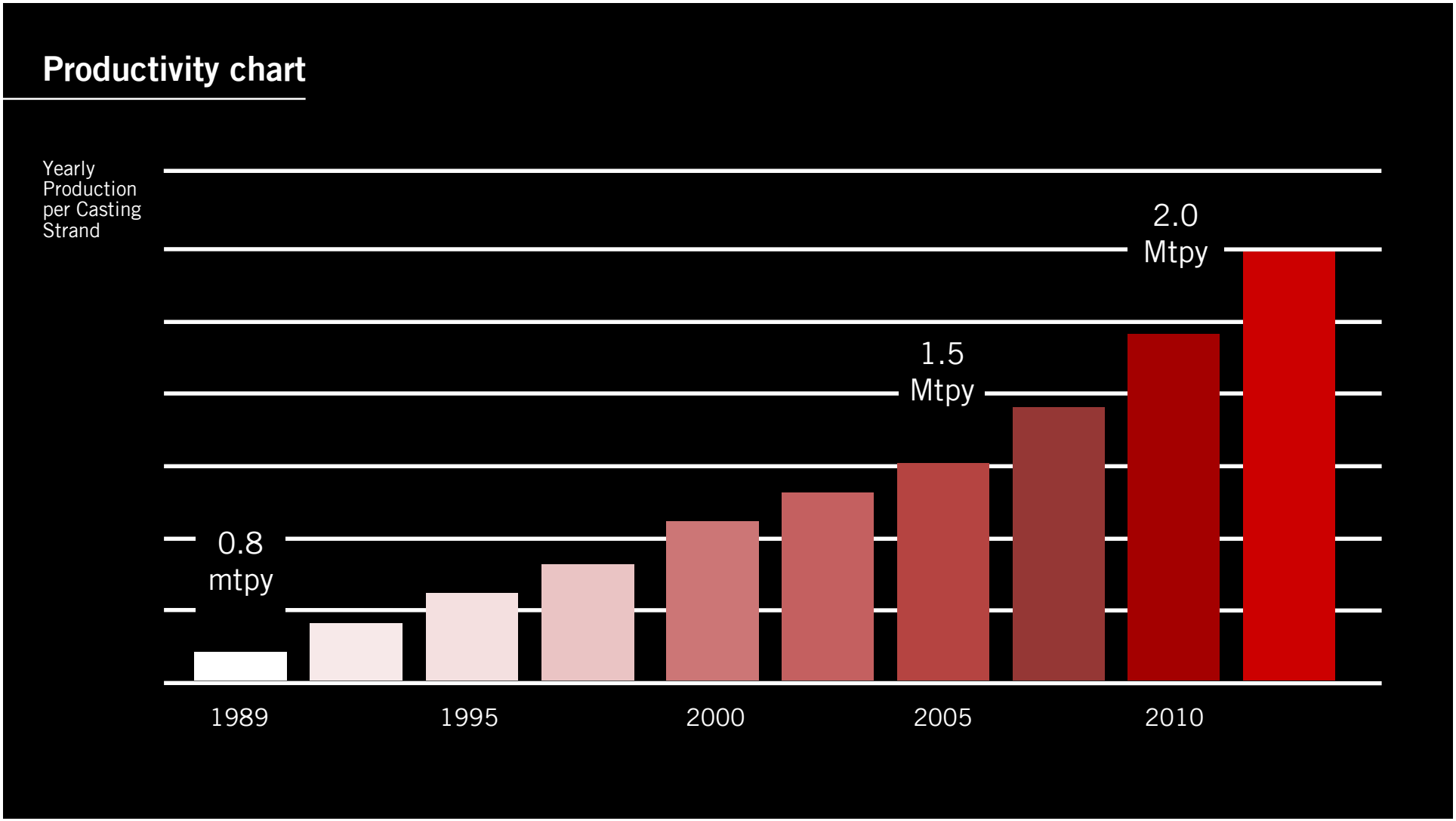
- Increasing in production level
- Extended product mix
- “Conventional mill style” coil quality
- High value production
- Ultra thin gauges production

The Danieli flexibility concept

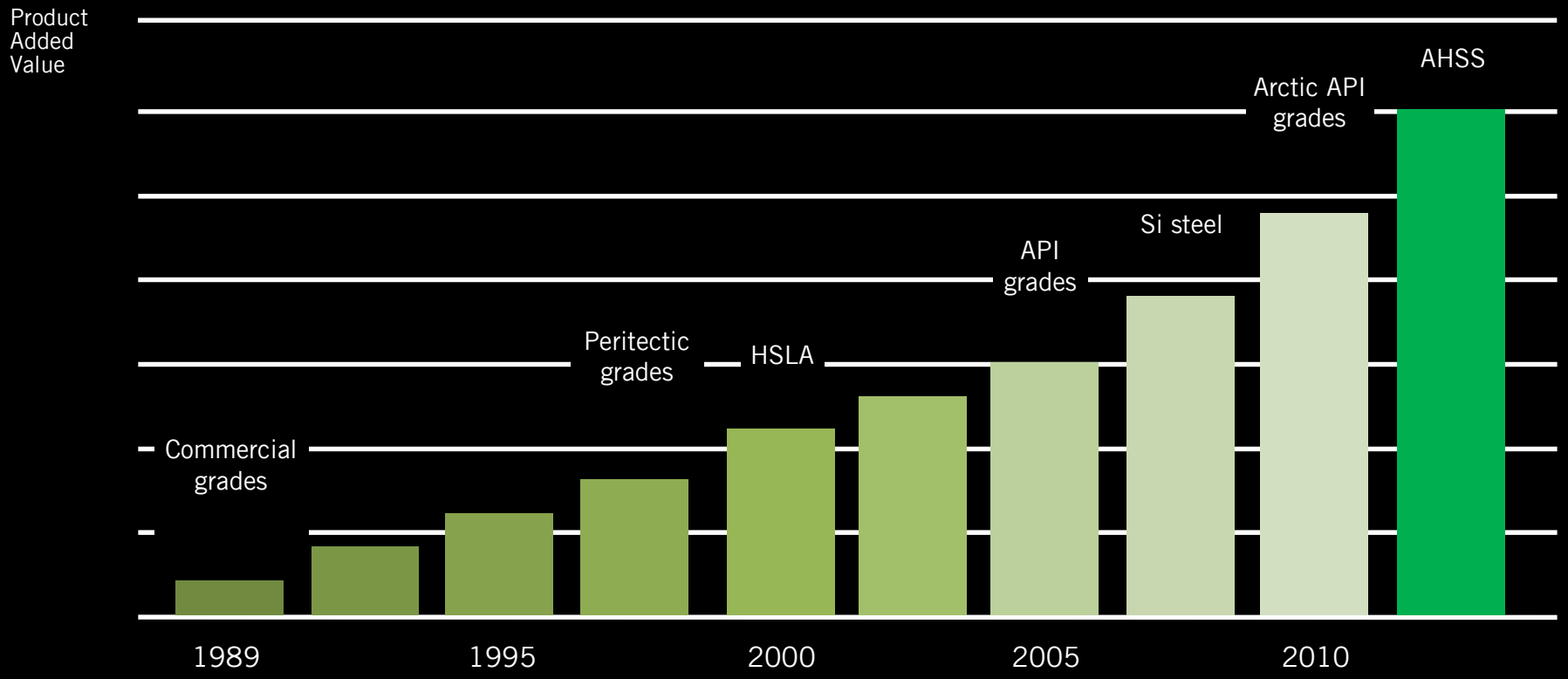
1984 first pilot caster plant based on Danieli original technology

- Productivity: increased output to reduce transformation costs
- New steel grades: AHSS, HSLA, Peritectic, Silicon Steels and API grades (including ARCTIC applications)
- New markets: top quality pipe applications and, as goal, automotive exposed

Productivity chart



Steel grade mix chart

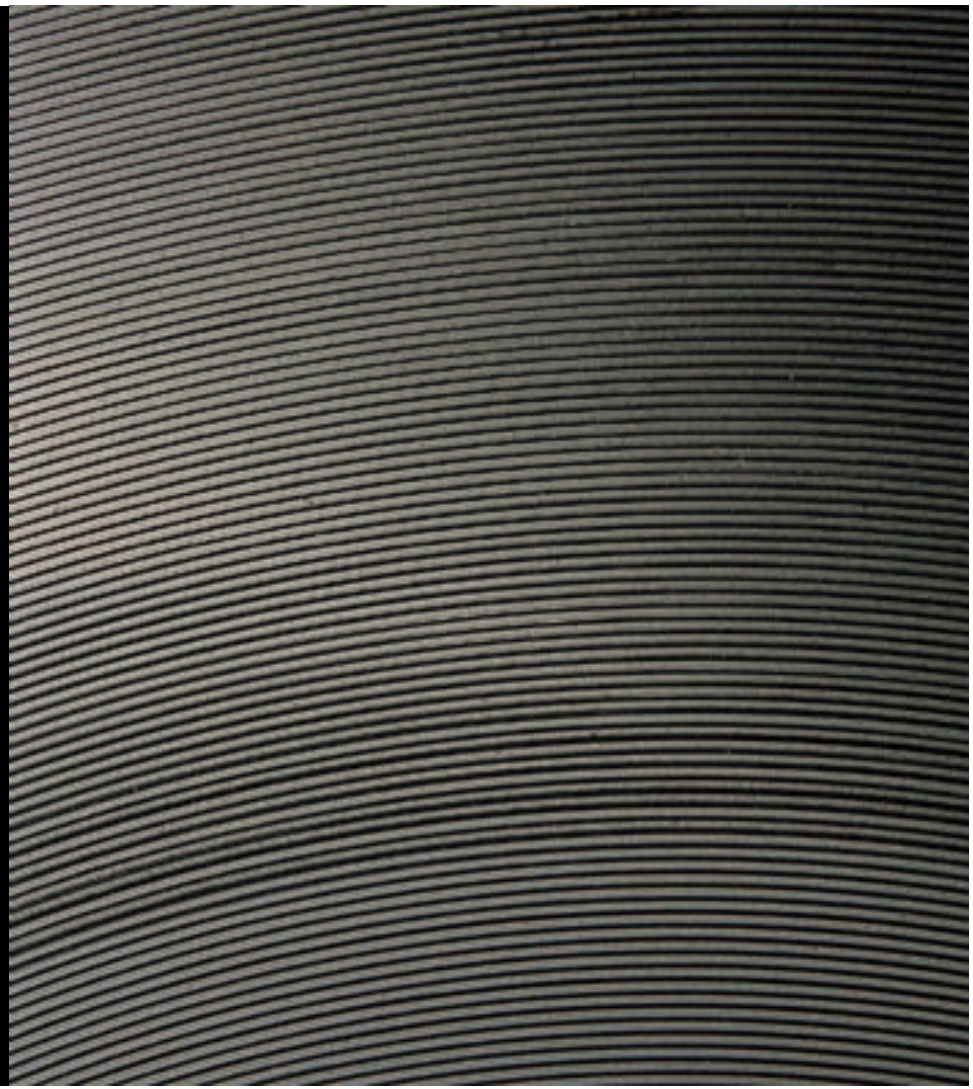


Thin Slab Casting Rolling: the ultimate goal

Danieli minimill concept
the new generation of minimill for flat products.

Close the “vicious gap” between conventional route and TSCR process in production and quality, keeping intact the “virtuous gap” in competitiveness concerning:

- Unbeatable CAPEX (20% advantage) and OPEX (15% advantage)
- Reduced environmental impact and carbon dioxide footprint



Flexibile minimill for productivity

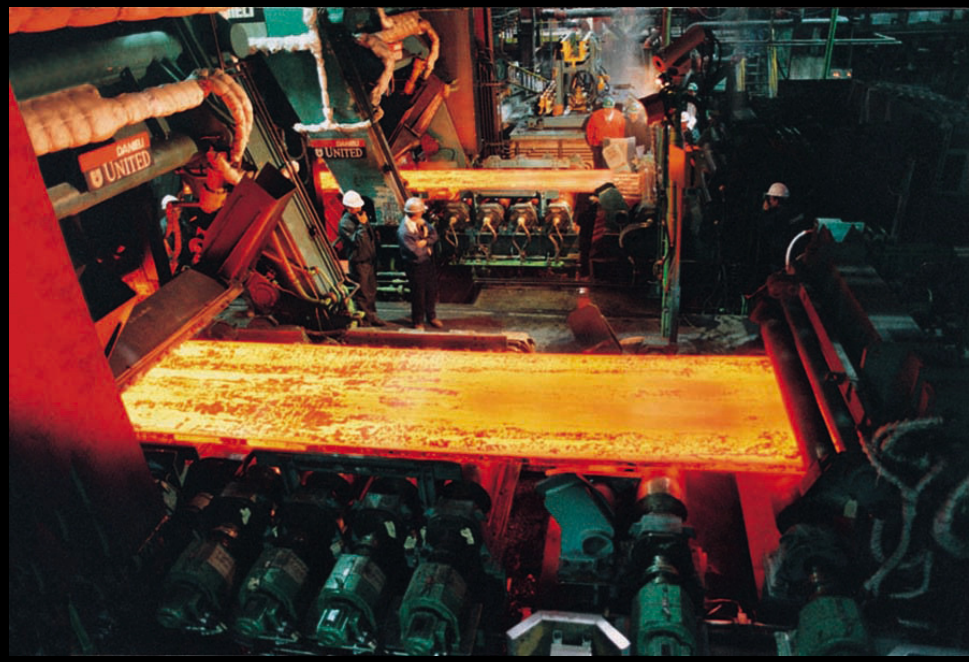
State-of-the-art
Tangshan Iron & Steel plant, TISCO (China) has been the first plant in the world able to produce in excess of 3.0mtpy of coils adopting thin slab casting and rolling process.

Flexibile minimill for productivity

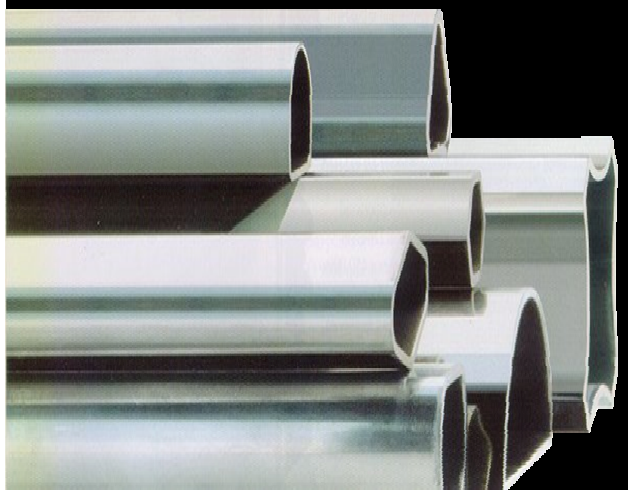
The evolution
With the new Danieli applications of Ultra High Speed casting consolidated in POSCO it is possible to exceed a plant productivity of 4.0mtpy.

Flexibile minimill for quality

Essar Algoma (Canada)
The first plant in the world to produce peritectic steel grades adopting thin slab casting and rolling process.
Danieli Thin Slab Casting process is the only technology that ensures the cast of these steel grades.



Essar Algoma - End user testimonials



"The 12" square by 0.250" was the flatest product we have ever seen.
There was significant reduction in our scrap rate and less set up time in our mill.

As for the scale, if the product had been oiled, I would have believed that the material had been pickled."

(Jim Clark, Director of Quality, Sonco Steel Tube Inc., Brampton, Ontario)

Essar Algoma - End user testimonials

"The surface was marvelous, almost like cold rolled."

(Sue Meagher, Maksteel Inc., Missisagua, Ontario)

Flexibile minimill for Quality

Essar Algoma developed HSLA grades with HIGH strength

- DSPC 700B/770B is a superior HSLA light gauge grade with minimum yield strength exceeding 700 MPa, for several applications including automotive, weathering grades, drawing quality.
- Surface quality of these steel grades produced in DSPC are reported to be higher that experienced in conventional Essar Algoma mill.

Flexibile minimill for Quality

Benxi Iron & Steel plant (P.R. China)

- Pioneering silicon steel production in China using Thin Slab Casting technology
- Several Si grades have been successfully cast at over 4 m/min with a Si content up to 3,2%

Flexibile minimill for Quality

Benxi experience:
customer reports

本溪钢铁（集团）有限责任公司技术中心理化检测所

Physical and chemical Testing Institute of Technical Center, BenXi Iron&Steel (Group) Co.,Ltd.

金相检验(分析)报告

共 4 页第 4 页　　LHS/4-09

委托单位	炼工艺室			检验编号	WB05
材　质		数量	18	试样状态	短流程铸坯
检验项目	硫印检验			委托日期	2005 /11/18
依据标准	YB 4003-1997			检验日期	2005/11/28
试样编号	5.1　5.2　6.1　6.2　7.1　7.2　7.3　8.1　8.2　8.3				

检　验　结　果

	5.1 5.2 50BW400	6.1 6.2 50BW400	7.1 7.2 7.3 X65	8.1 8.2 8.3 X65
中心偏析（级）	C0.5	C0.5	C1.0	C1.0
针孔状气泡（级）	0	0	0	0
中间裂纹（级）	0	0	0	0
角裂纹（级）	0	0	0	0
三角区裂纹（级）	0	0	0	0
Al2O3 夹杂（级）	0	0	0	0
蜂窝状气泡（级）	0	0	0	0
表面细晶粒区（mm）	3	4	7	7
柱状晶区（mm）	75	74	67	67
中心等轴晶区（mm）	2	2	6	6

备注：本次检验的试样厚度不在 YB 4003-1997 规定的厚度范围内，结果仅供参考。

声明：1. 本报告仅对来样负责；2. 报告无签发人签名和公章无效；3. 报告经涂改无效；
4. 未经实验室书面批准不得复制本报告（不全全复制）；
5. 委托单位对检验结果的异议申诉须于报告发出日起 15 天内提出。

汇　总	
审 核 人	
签 发 人	
日　期	2005 年 11 月 30 日

公章

地址：本溪市平山区胜利路 12 号　　邮编：117000　　电话：（0414）782712

Translation of Benxi Quality Department report

entrusted unit	steel making technical offie			inspection code	WB05
material		quantity	18	sample state	thin slab
inspection item	macroetch inspection			entrusted date	Nov.18/05
evaluation stand.	YB 4003-1997			Inspected date	Nov.28/05
sample code	5.1, 5.2, 6.1, 6.2, 7.1, 7.2, 7.3, 8.1, 8.2, 8.3				

Inspection Result

	5.1 5.2 50BW400	6.1 6.2 50BW400	7.1 7.2 7.3 X65	8.1 8.2 8.3 X65
center segregation (degree)	C 0.5	C 0.5	C 1.0	C 1.0
center porosity (degree)	0.5	0	1.0	0.5
center cracks (degree)	0	0	0	0
triangular cracks (degree)	0	0	0	0
triangular zone cracks (degree)	0	0	0	0
Al2O3 inclusion (degree)	0	0	0	0
cell shape blow holes (degree)	0	0	0	0
surface gain zone (mm)	3	4	7	7
column crystal zone (mm)	75	74	67	67
center equal axile zone (mm)	2	2	6	6

Declare: 1. report is subject to samples. 2. it is unvalid without signature of issuer. 3. it is unvalid with hands change. 4. it is forbidden to copy the report without lab approval on paper. 5. any claim or discrepancy to analysis result must be put forward within 15 days from issued data.

Dada collection by	Cao Xie-Tao
Checked by	Tian Yu-Dai
issued by	
Date	Nov.30th, 2005

Flexibile plant for outstanding performance

OMK plant (Russia)
the first thin slab casting and rolling plant in the world specifically conceived for the production of top quality pipe grades (including arctic applications)

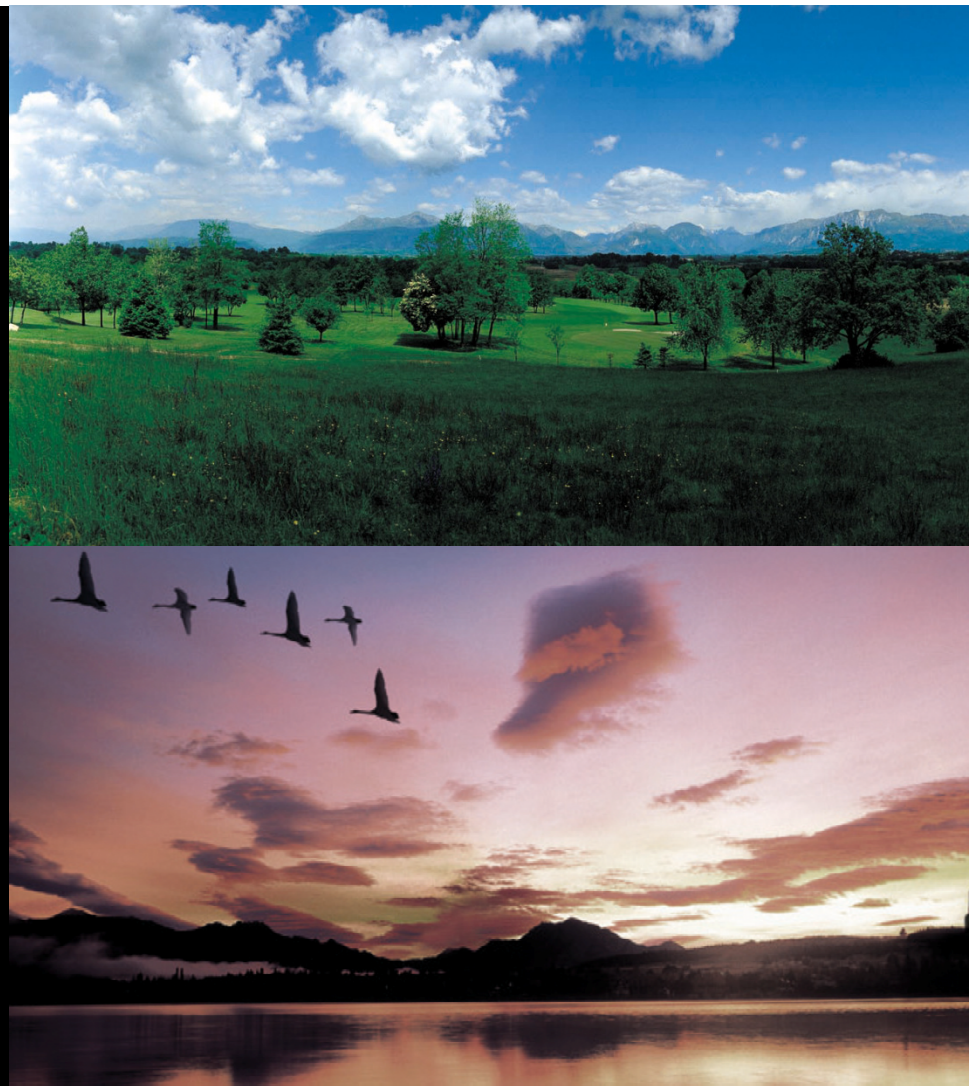
Flexibile Plant for Outstanding Performance

More than 20 steel grades for pipe steel are already in production

Steel group	Steel grades
HSLA MC	13G1SU, 17G1SU, 20KSX, 22GU, 22GU-1, 22GU-2, 22GU-E, 22GF
MC	ST20, St3sp, S235JR-3, A36, S235JR-1
HSLA LC	K52, K56, K60
PERITECTIC	09G2S, 09GSF
LC	St08ps, S235JR-2, SAE1006, St1SP

Flexibile minimill for minimized environmental impact

The energetic efficiency embodied in the thin slab casting and rolling process reduces the overall energy consumption and related carbon dioxide footprint to less that 35% compared to conventional process.



Danieli concept: flexibile minimill

"Investment oriented" key design factors:

- Definition of slab thickness
- Definition of mill layout and process
- Modular solutions for future upgrades

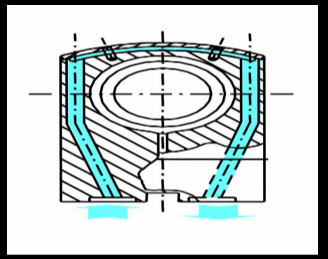
Danieli concept: flexibile minimill

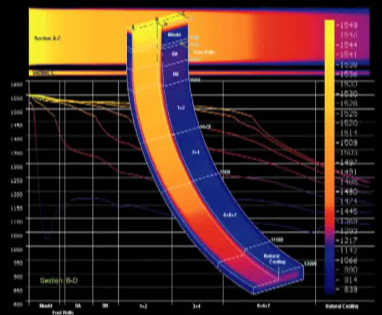
Danieli developed a comprehensive portfolio of layouts and technological solutions to get the best transformation cost fitting with:

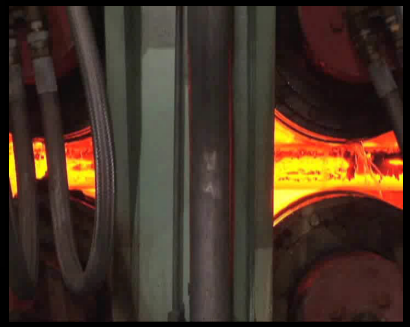
- Production level according to market request
- Product mix (steel grades and coil dimensions)
- Possible future expansion

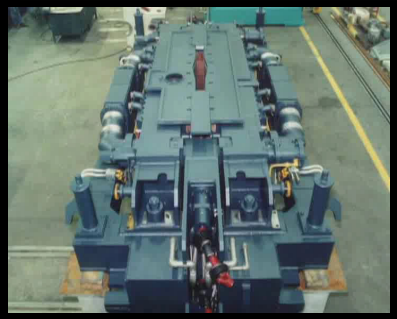
fTSC defining features

- Danieli **Vertical Curved** caster design vs. vertical design
- Danieli **High Speed High Quality (H^2) Long funnel Mould** vs. conventional funnel mould
- Danieli **Dynamic Soft Reduction** with mathematical model vs. static soft reduction
- Danieli **Air Mist** secondary cooling vs. water only secondary cooling
- Danieli **Independent Machine Cooling** vs. no dedicated machine cooling





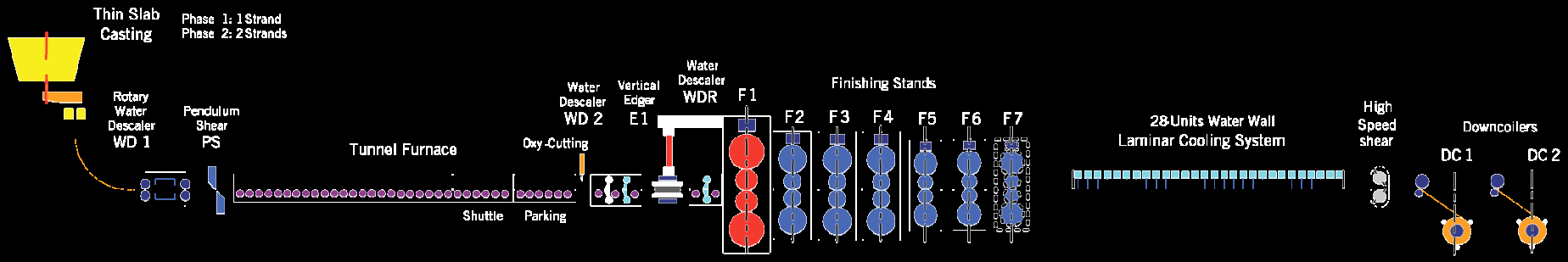




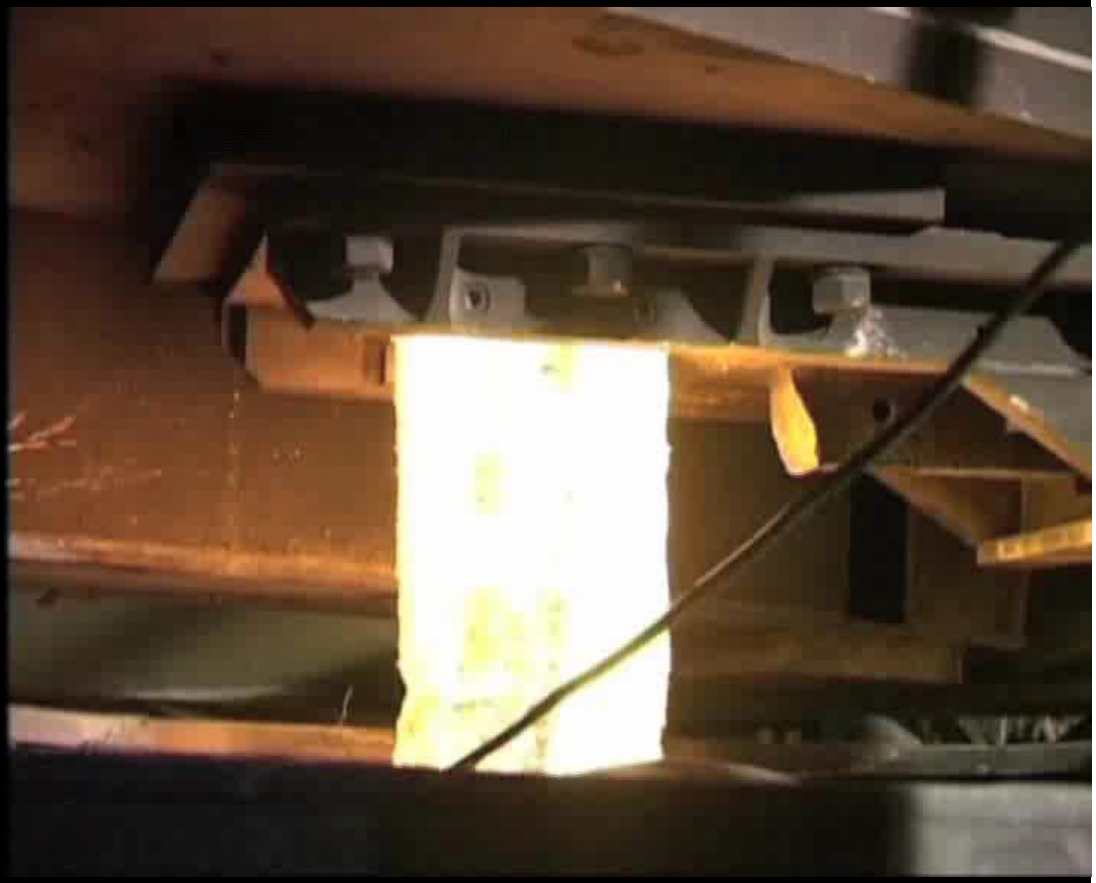
TSR technological layout

TSR for 1.6/2.0 Mtpy of Hot Rolled Coils with 1 strand caster

Slab thickness	50/70/80 mm	**Strip min max thickness**	(0.8) 1.0 - 20 mm
Slab min max width	800-1600 mm	**Strip min max width**	800-1600 mm
Max slab length	38-150 m	**Max coil sp. weight**	20 kg/mm
Max slab weight	30 t	**Coil nominal ID-OD**	762-2000 mm
		Max coil weight	30 t



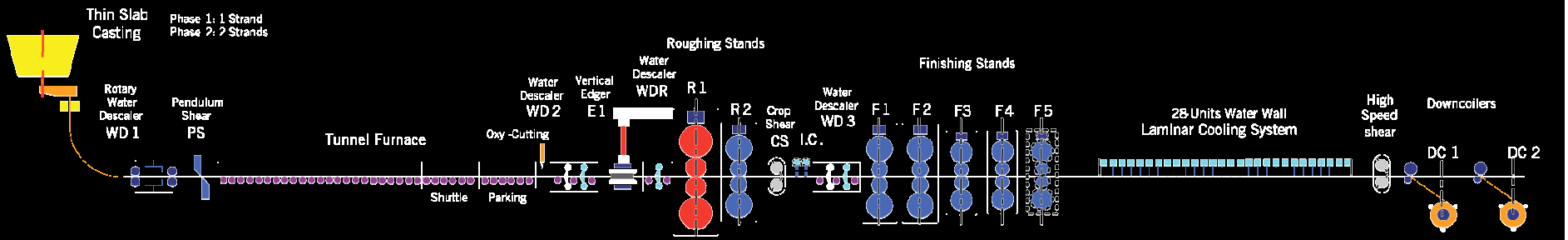
SABA plant (Iran)



fTSR Technological layout

fTSR for 1.6/2.0 Mtpy of Hot Rolled Coils with 1 strand caster

Slab thickness	50/70/80 mm	**Strip min max thickness**	(0.8) 1.0 - 20 mm
Slab min max width	800-1600 mm	**Strip min max width**	800-1600 mm
Max slab length	48 m	**Max coil sp. weight**	20 kg/mm
Max slab weight	30 t	**oil nominal ID-OD**	762-2000 mm
		Max coil weight	30 t

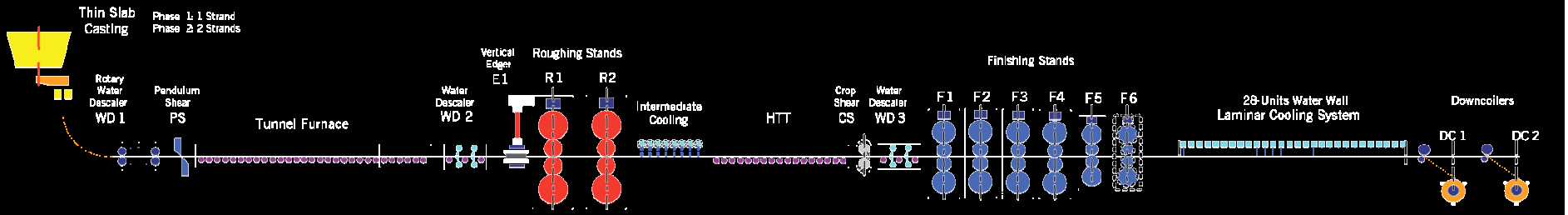


TISCO plant (P.R. China)

QSP 90 technological layout

QSP 90 for 1.8/2.2 Mtpy of Hot Rolled Coils with 1 strand caster

Slab thickness	90 mm	**Strip min max thickness**	1.0 - 20 mm
Slab min max width	800-1600 mm	**Strip min max width**	800-1600 mm
Max slab length	30 m	**Max coil sp. weight**	20 kg/mm
Max slab weight	30 t	**Coil nominal ID-OD**	762-2000 mm
		Max coil weight	30 t

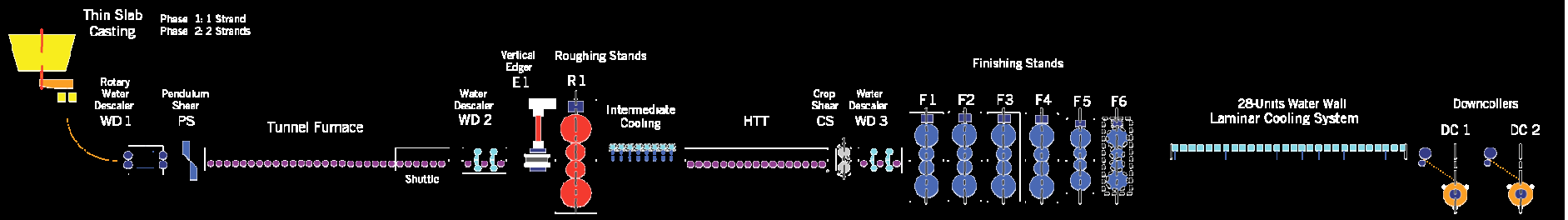


OMK plant (Russia)

QSP 70 technological layout

QSP 70 for 1.6/2.0 Mtpy of Hot Rolled Coils with 1 strand caster

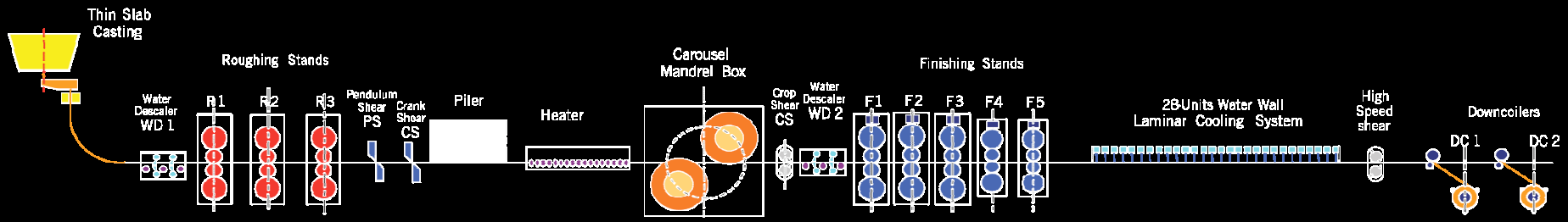
Slab thickness	70 mm	**Strip min max thickness**	1.0 - 20 mm
Slab min max width	800-1600 mm	**Strip min max width**	800-1600 mm
Max slab length	38 m	**Max coil sp. weight**	20 kg/mm
Max slab weight	30 t	**Coil nominal ID-OD**	762-2000 mm
		Max coil weight	30 t



ETR technological layout

ETR for 2,2/2,6 Mtpy of Hot Rolled Coils with 1 strand caster

Slab thickness	80 mm	**Strip min max thickness**	(0.8) 1.0 - 20 mm
Slab min max width	800-1600 mm	**Strip min max width**	800-1600 mm
Max slab length	NA	**Max coil sp. weight**	20 kg/mm
Max slab weight	30 t	**Coil nominal ID-OD**	762-2000 mm
		Max coil weight	30 t



POSCO plant (Korea)

- The fastest caster in the world:
  over 7 m/min in steady state operation
- The most productive minimill in the world:
  1.8 Mtpy with one casting strand only
  and **1.3 m** max coil width

POSCO plant (Korea)

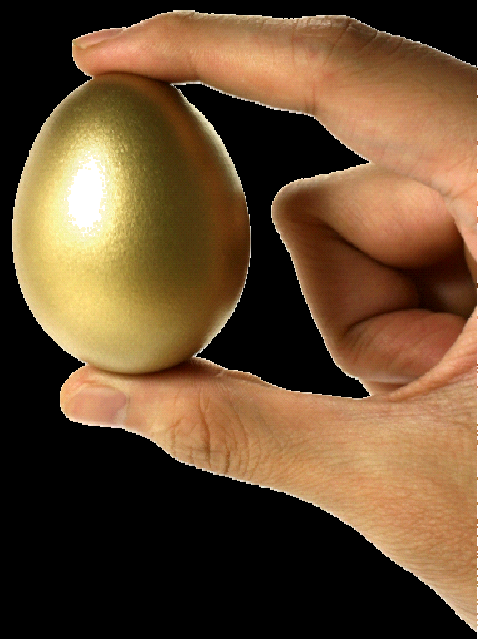
- The fastest caster in the world:
  over 7 m/min in steady state operation
- The most productive minimill in the world:
  1.8 Mtpy with one casting strand only
  and **1.3 m** max coil width

Conclusions

Productivity

Conclusions

Quality



Conclusions

Modular process and layout solutions, market oriented

Outlook

To suit the specific requirements of the customers, Danieli Minimills have the following flexible solutions for hot rolled coil production:

- **TSR** (Thin Slab Rolling) – coil to coil/semi-continuous rolling
- **fTSR** (flexible Thin Slab Rolling) - coil to coil/semi-continuous rolling
- **QSP** (Quality Strip Production) - coil to coil
- **ETR** (Extra Thin Rolling) - coil to coil/endless rolling

Thanks for your kind attention