擠乳式擠乳機器人
Automatic Milking Systems

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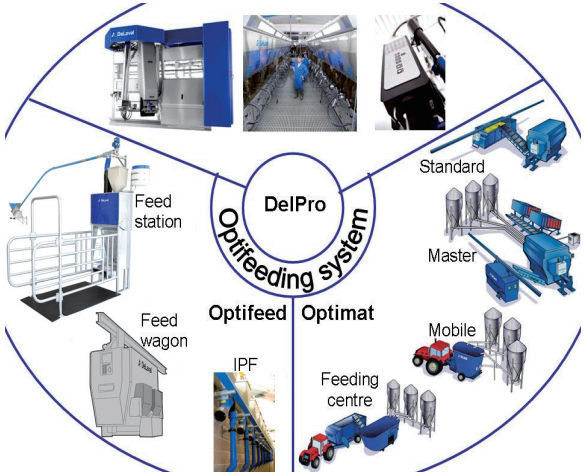
使用機器人的乳牛舍設計研討會暨2016年天噸牛獎項頒獎會
Dairy Cattle Farm Designs with Robotic Systems
Prolific Ten Tons Cow Award & Elite Cow Award

2017年1月17日

Automatic Milking Systems
擠乳式擠乳機器人

自動化牧場配置



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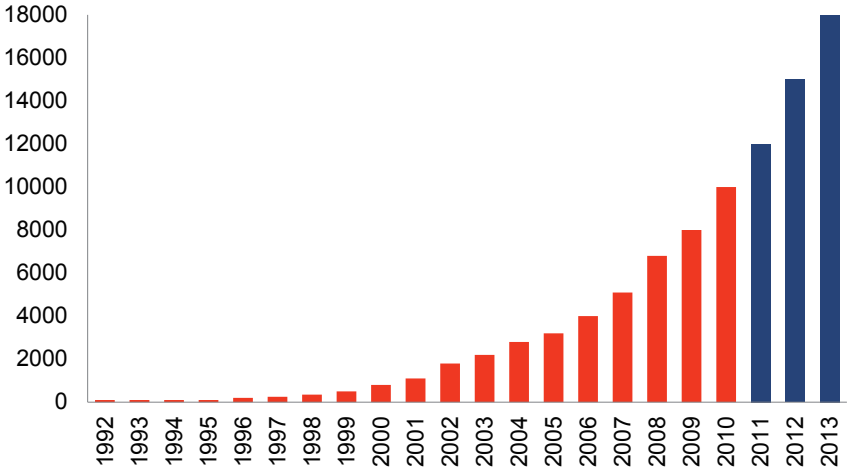
自動化牧場配置

AMS around the world (2013 >18.000 farms)
全自動擠奶機器人全球情況（2013年>18.000牧場）



Source: de Koning CJAM. Netherlands (red bars only)

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Delaval全球機器人牧場主要分布2013

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國際機器人協會2013預測未來展望

>20,000牧場
>30,000台機器人
>2,000,000 奶牛
>6,000,000頭次/天
~60% 新牧場使用機器人

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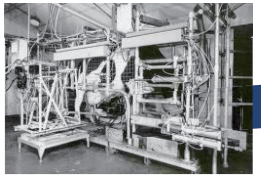
優質牛奶
健康牛隻

DeLaval 機器人重大的演進紀錄表

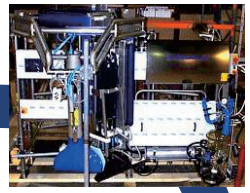
VMS 1994-8	VMS 2000-3	VMS 2004	VMS 2005-6	VMS 2007-8	VMS 2009	VMS 2010	VMS 2011
Test, prototype and design versions	2000: Teat preparation with 5th cup, Touch screen	Flow controlled cooling, FCC	Hydraulic robot arm cylinders	Complete new station design	Master & slave milk transport for large herds	Delpro 3.0 herd management software	Smart milking and cleaning milk software
	2001: New camera cleaner introduced	New herd managment software, Mildea	Blood detection	Build in floor Build in cleaning unit Build in hydraylic pump All resulting in faster installation	BCC buffer controlled cooling	Steam back flush	Introduction buffer tank BVV
	2002: Introduction milk divert unit	Frequency changer for BVP-700 vacuum pump	DVP900F direct driven vacuum pump with FC	Online Cell Counter as option	New VMS gates assortment	Herd Navigator for VMS	Twin filter
	2003: New magazine improves milk tube guiding	2004: Robustness improvement & cost reduction	2006: 3A/PMO approval for USA	Passive air-inlets reduces power consumption	Central vacuum supply for 2-4 stations	New touch screen SW	Pre-cooling for VMS
				Manure robot for VMS barns	2008: Robustness improvement & cost reduction	Extended teat cup for short teats	Integration Optimat in Delpro 3.5 HM-software

With VMS already in the beginning:
- 5th cup with water only
- Teat search even for cleaning
- Interactive easy to use TouchScreen
- Smallest arm in market with biggest reach
- Automated hygiene
- Diverting to distance
- Milk buffering option
- Smallest footprint
- Windows pc software
- Possibility to milk all cows

Delaval 機器人1982-2017年的演進過程



1982: 樣品的開發



1997: 開始商業化

2010:帝波羅及牛群導航儀

2007: OCC 在線體細胞檢測

2002: MDI技術及牛奶自動分流

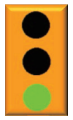
2015:BCC體能評分儀

更準確更自動更耐用

2002: MDI 乳房炎偵測指標1-4: 乳房炎&分流

General			Counters Udder/Teat Level					Conductivity (mS/...				Udder			Milking			Percent of Expect...			Kick off				Blood (ppm)				Incomplete				SCC (x 1000)	
Animal Number	DIM	Milking Start Time	Udder	LF	RF	LR	RR	LF	R			Risk For Mastitis	MDI	Average OCC Last 7 d	Last OCC (x 1000)	Avg MI	MI>12	R	L	LF	RF	LR	RR	LF	RF	LR	RR	LF	RF	LR	RR	SCC (x 1000)	SCC Date
326	284	1-3-2012 8...	3	2	0	0	0	5,5	4,8	4,4	4,4	8	1,4			8	00:45	7	77	81	80	76	0	0	0	0	0	0	0	0	0	0	0	0	
346	172	1-3-2012 1...	1	0	1	0	0	3,1	4,9	3,6	3,5	5	1,4			4	10:03	0	98	98	100	96	0	0	0	0	0	0	0	0	0	0	0	0	
14	279	1-3-2012 9...	7	0	9	10	0	4,3	5,5	5,9	4,8	4	1,4			7	09:05	0	106	113	83	92	0	0	0	0	0	0	0	0	0	0	0	0	
327	266	1-3-2012 8...	0	0	0	0	0	4,5	4,2	4,1	4,0	2	1,3			8	19:02	9	101	79	99	88	0	0	0	0	0	0	0	0	0	0	0	0	
377	351	1-3-2012 7...	0	0	0	0	0	2,9	3,8	3,6	3,8	0	1,3			9	20:51	7	96	96	99	89	0	0	0	0	339	0	0	0	0	0	0	0	

1. 導電度
2. 血奶
3. 奶量
4. 擠奶的間隔
5. 擠奶過程



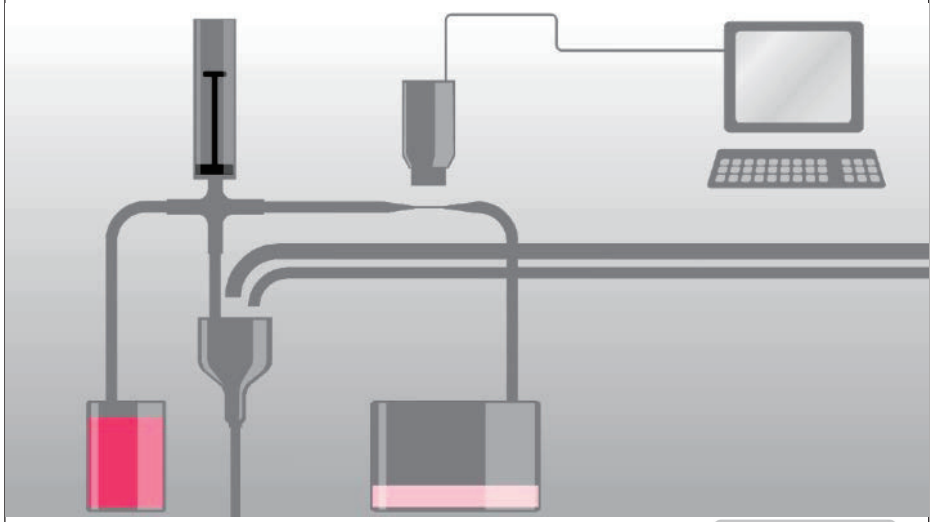
良好

檢查

隔離及分流

MDI 利用各方面的數據來分析牛隻的乳房健康狀況進而把問題牛奶做分流

2007: OCC 在線體細胞測試儀95%: 乳房炎&分流



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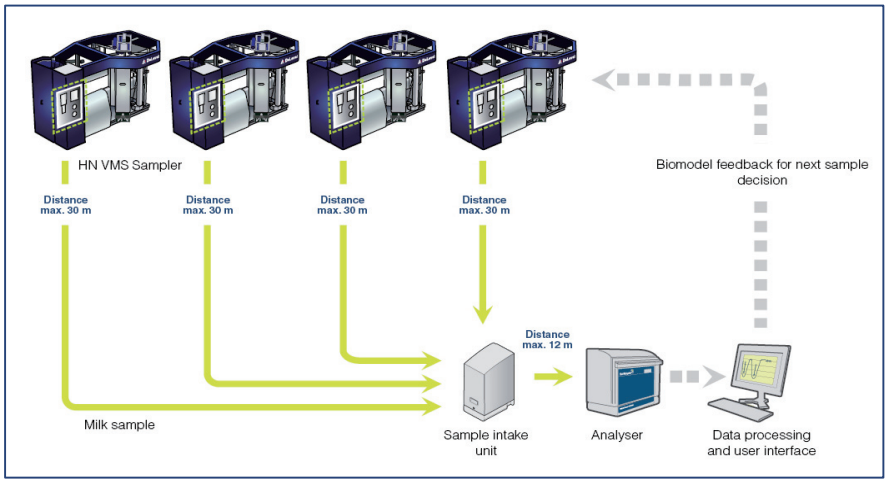
2010: 牛群導航儀:線上監測乳牛生理指標



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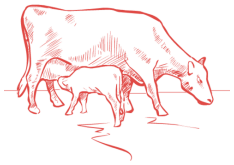
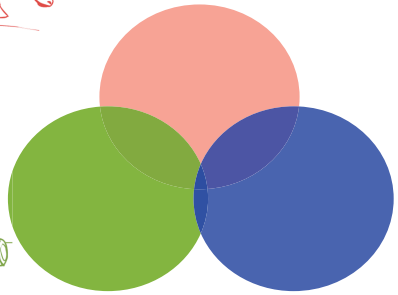
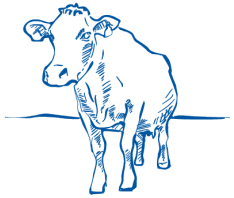
HN牛群導航儀



Reproduction 繁殖

Progesterone 孕酮(黃體激素)





Feeding 餵飼

Beta Hydrox butyrate (BHB) + Urea

β- 羥基丁酸 +尿素

Udder health 乳房健康

Lactate Des hydrogenase (LDH)

乳酸脫氫酶

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牛群導航儀 – 敏感度&特異度

參數	Sensitivity 敏感度	Specificity 特異度
乳房炎(LDH乳酸脫氫酶)	80%	98%
發情監測(孕酮)	95%	98%
懷孕/流產監測(孕酮)	>90%	99%
黃體囊腫(孕酮)	90%	99%
卵泡囊腫(孕酮)	70%	95%
酮症(BHB+尿素)	>80%	95%

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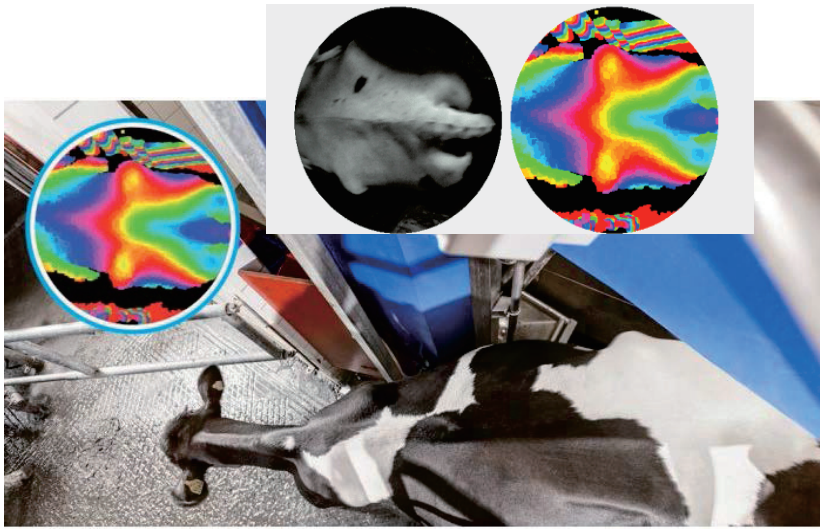
2015: BCS 3D自動體態評分儀: 牛隻健康指標



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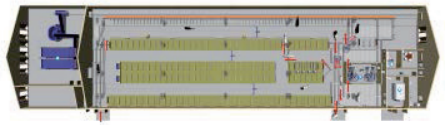
機器人牛舍的3種不同設計

Milk First™

擠奶優先:
適合高精料TMR

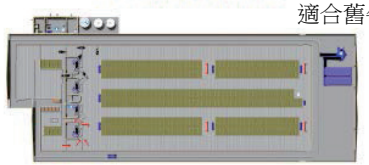
Feed First™

採食優先:
適合低精料TMR



Free cow traffic

自由通道:
適合舊牛舍但效率低



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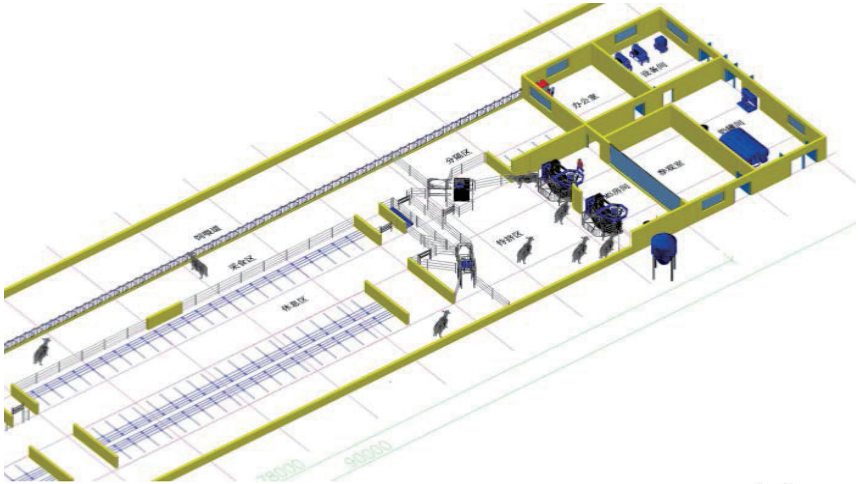
擠奶優先牛舍設計圖



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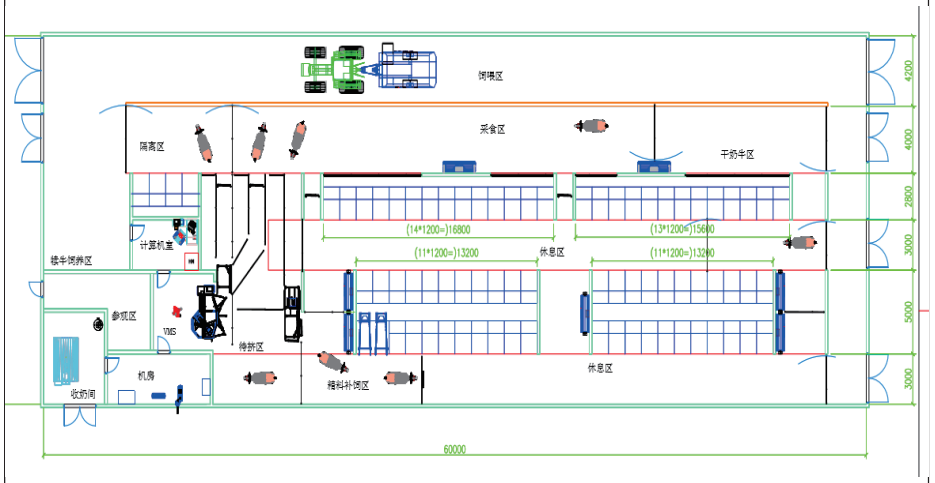
採食優先牛舍設計圖



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採食優先立體圖
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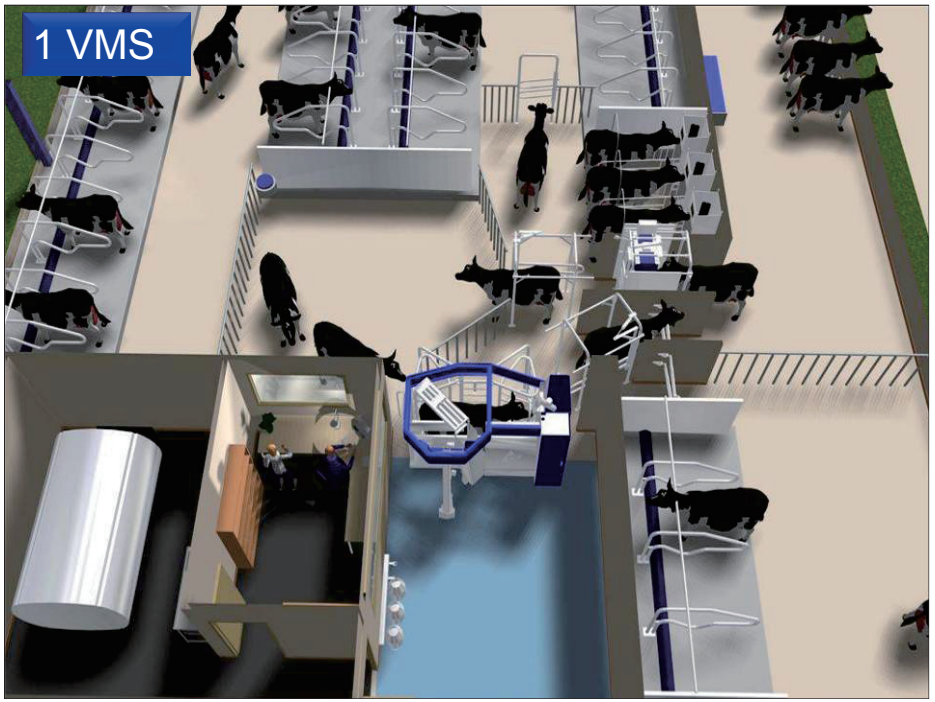
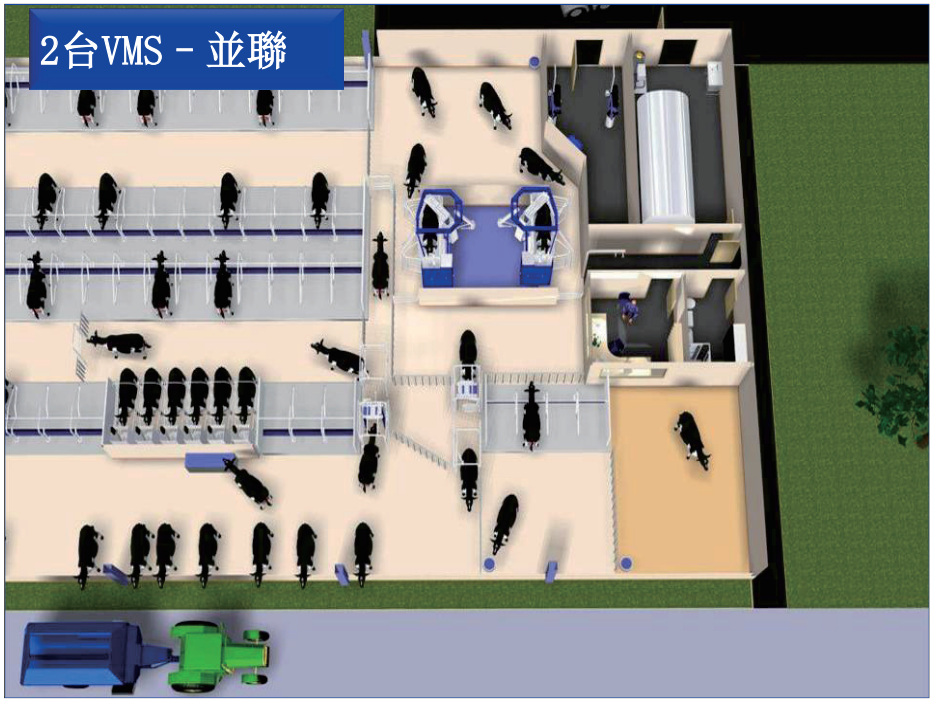
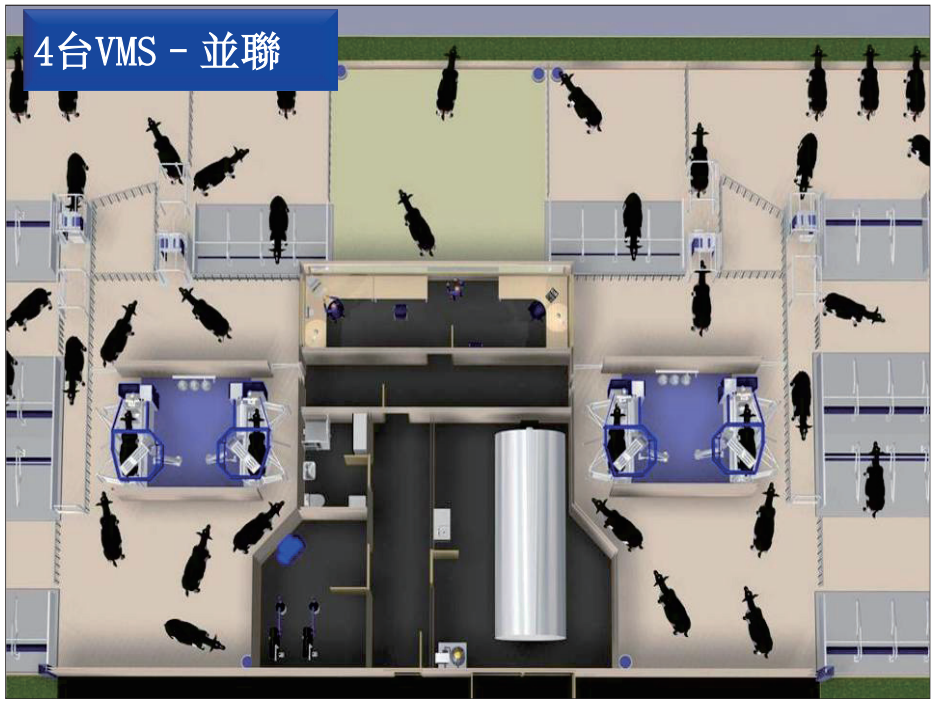

1 VMS

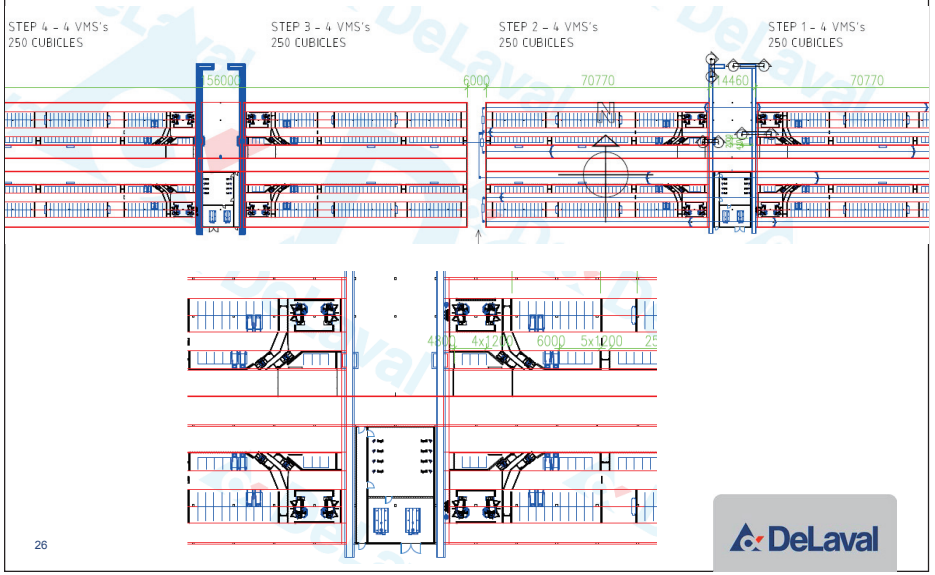

2台VMS－並聯

2台VMS－串聯

4台VMS－並聯



上海希迪牧場 － 16 VMS 2x8 泌乳牛1000頭



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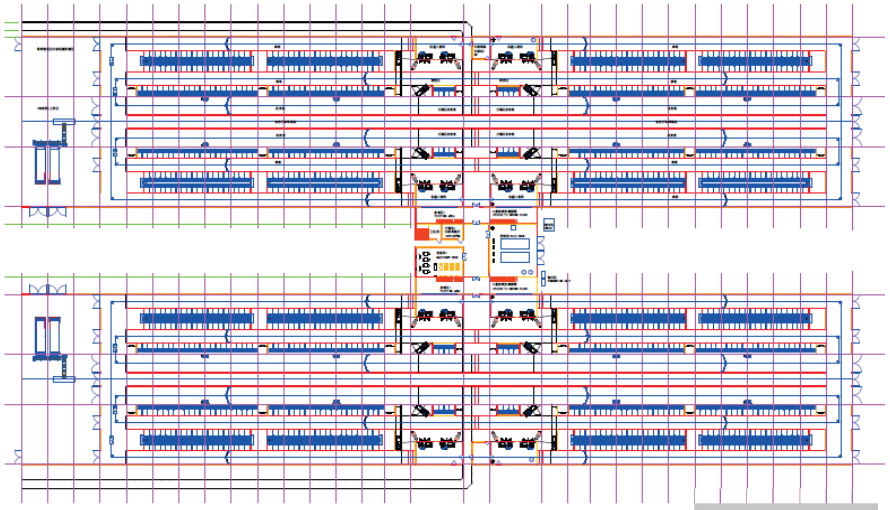
北京三元牧場 － 16VMS 2x8 泌乳牛1000頭



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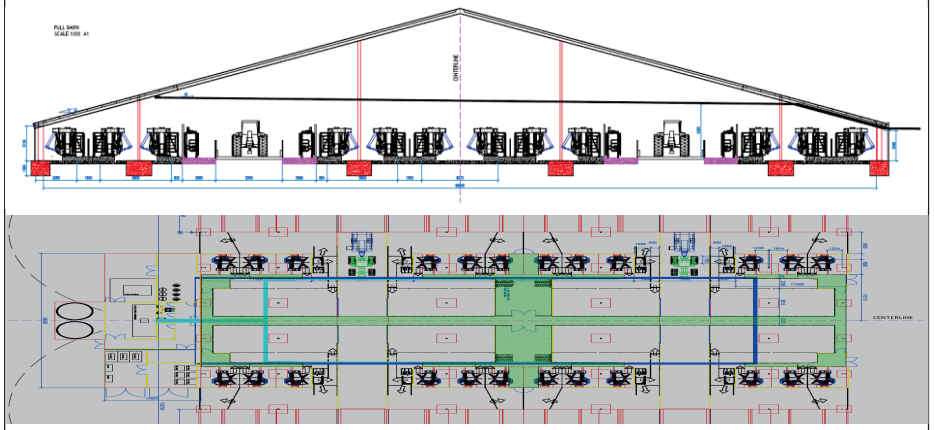
紐西蘭Van Leeuwen牧場 －24VMS 3x8 泌乳牛1500頭



24台VMS™系統負責1500頭奶牛擠奶，並將牛奶輸送至牛棚外的2個儲奶罐內
24台VMS™系統被分為8組，每組3台，每台負責60-65頭奶牛的擠奶工作
該牧場還配備了線上體細胞測試儀（OCC）和牛群導航儀（Herd Navigator™）系統

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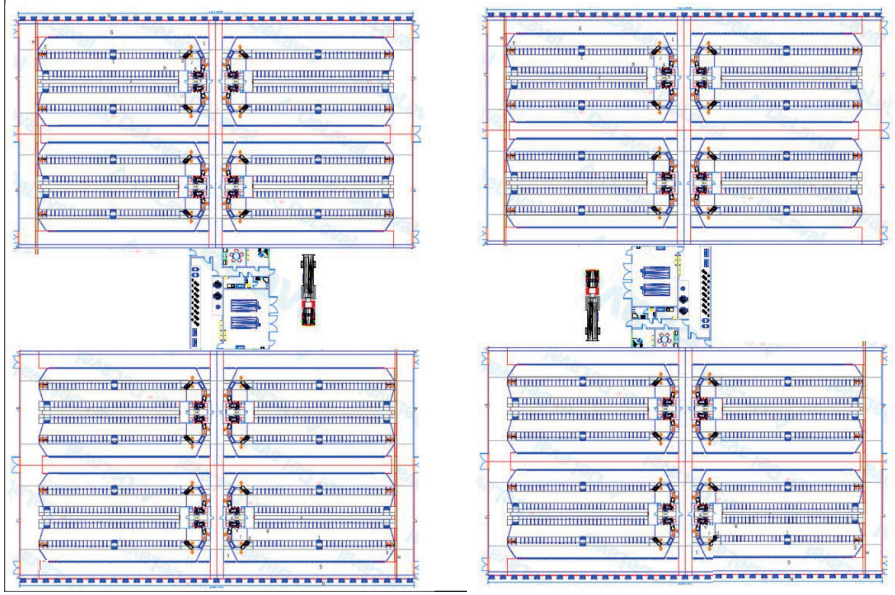
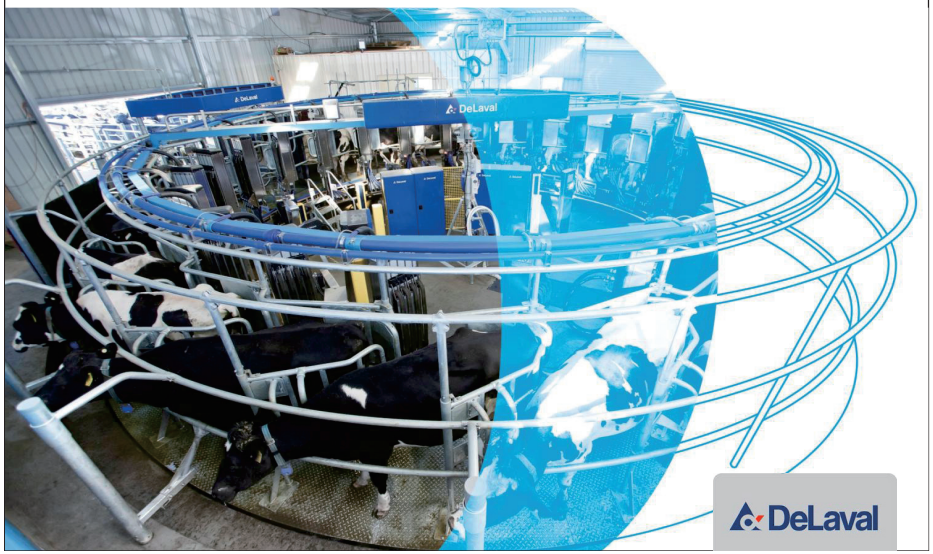
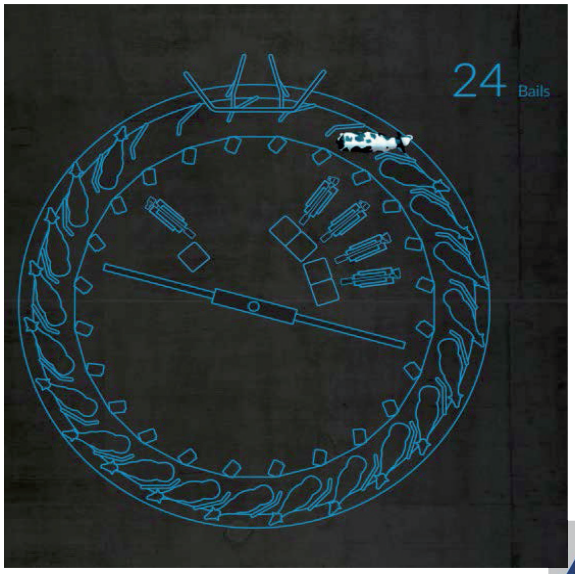
智利Ancali - 32VMS 2x16 泌乳牛2000頭



DeLaval AMR™
2010:Delaval 圓盤機器人



Delaval圓盤機器操作說明