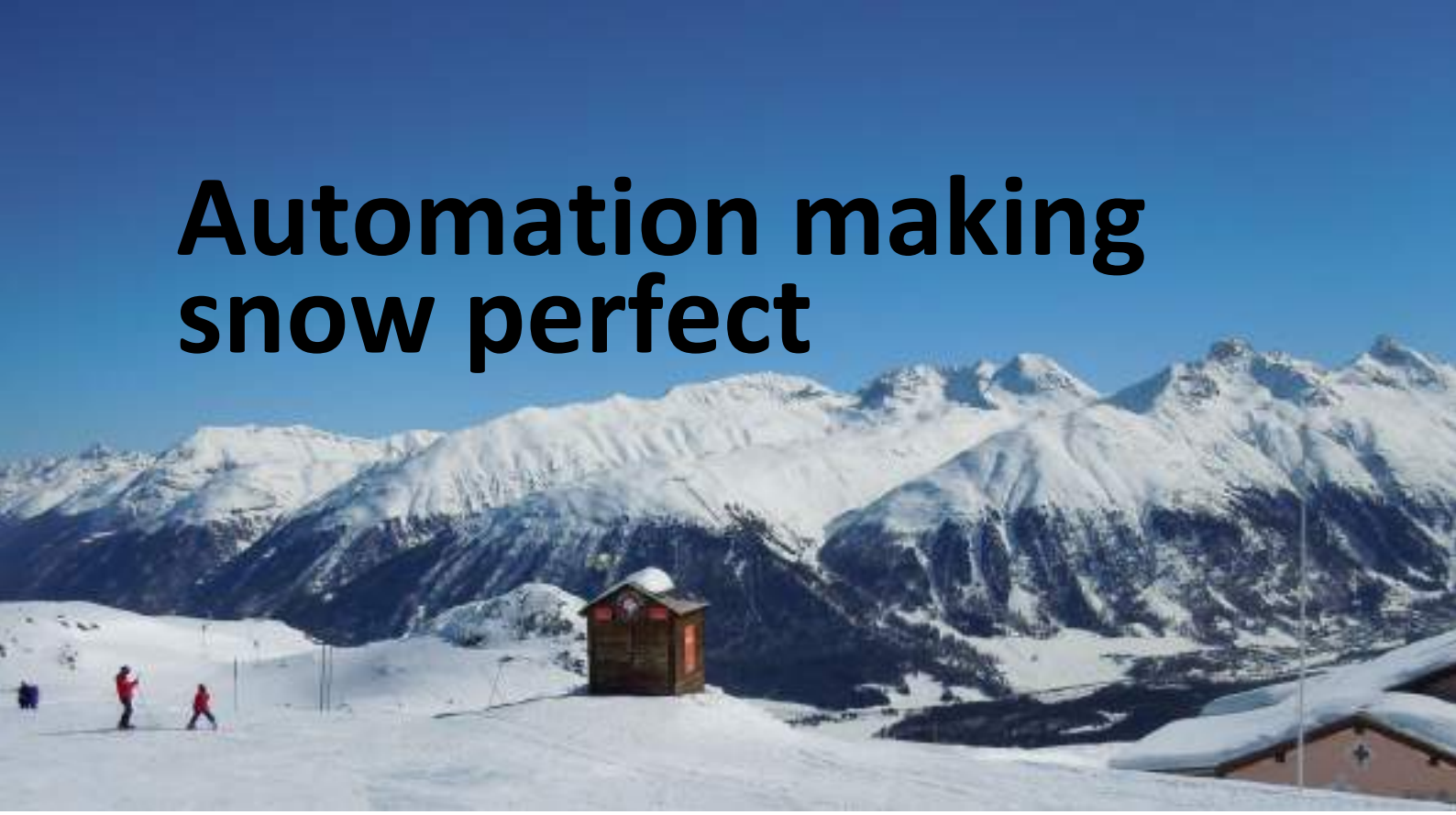
Automation making snow perfect



The sophisticated artificial snow technology at St. Moritz (CH) ski resort uses Movicon to ensure perfect snow and energy consumption efficiency

Today, modern ski resorts worldwide are the heart of the tourist trade in all the important mountain holiday locations. Tourists who spend their holidays in the mountains constitute a major part of hotel tourism economy in winter combined with other activities such as restaurants, handicrafts, transport, and passes to the ever increasing fast and capacious ski lifts. However this mostly depends on whether there is enough snow being the main factor that attracts tourists to the winter mountain resorts. This means that substantially the entire economy of the big hotel resorts are conditioned by this one element alone: snow on the ski slopes. Furthermore the snow must contain a certain consistency and quality to ensure that skiers and snowboarders enjoy their winter holiday experience. It is for this reason that the local ski resort community has placed its trust in modern technology to produce artificial snow to ensure that the ski slopes remain open and in operation throughout the winter season to provide skiers with perfect and homogeneous snow.

The snow making system however, needs to be engineered accurately, not only for guaranteeing quality snow productivity but primarily to optimize energy and water consumption in way that is also environment friendly. To accomplish this great competence and experience is needed to deploy the best automation technology available on today's market, both in terms of hardware (considering below zero temperatures and temperature changes) and in terms of supervision and control management software.

Based on these requirements one of the most famous ski resorts in the world in St. Moritz, run by the "St. Moritz Engadin Mountains" organization recently renewed its entire artificial snow system. They decided to deploy an extremely innovative solution

capable of improving productivity efficiency, reducing energy consumptions and joining the West and North slopes under one management system.

Artificial snow process

Artificial snow is produced with a process that replicates the natural snow process based on water. The water is pumped through nebulizers defined "snow cannons", positioned in those points where snow is needed. The water is pumped and nebulized when entering the machine to form very small droplets of water which are frozen instantly upon contact with the air below zero temperatures (usually below -6 °C, -7 °C) to then become tiny ice crystals. Therefore by combining water and compressed air in the right proportions and exposing it to freezing conditions it is possible to obtain a nucleation of points to form snow-like ice crystals. These crystals are then again mixed with vaporized water replicating the natural snow process as intended by nature. The water deposits around the ice nucleation and forms snow crystals which settle on the ground due to the effect of gravity. Practically, the snow cannon imitates the natural snow process in fast motion. In addition, it is essential that the temperature and humidity conditions are ideal. For instance, the transformation of water to snow is more effective when there is low humidity. By obtaining this condition the structure of the frozen particles become more compact and spherical and therefore greater in density than natural snow.

DEMACLENKO is a joint venture between two leading companies in the snow technology sector, DEMAC from Selva in Val Gardena, and LENKO, from Oestersund in Switzerland. The two companies went into operation in the 80's producing snow generators and during the 90's both Demac and Lenko started studying applications for automating their systems to become more technologically advanced. In 1991, Lenko launched a semi-automatic snow canon and in 1994 Demac launched their first fully automatic canon with central air supply system. This revolutionary breakthrough soon gained great success: both companies expanded their market shares and increased exportation abroad.

The snow generators are complex machines that need the right technology and know-how. They are all connected in net with the automation system.

This enabled them to open branches in other strategic countries such as Austria, Italy, Switzerland and the USA to satisfy the continuous and increasing demand for their products. The companies only recently decided to merge as a joint venture to form the DEMACLENKO company as part of the LEITNER group. Operating at an international level in the ropeway, snow groomer vehicle, urban transport and wind turbine system sectors, the company recorded a turnover of 795 million euro in 2011 and now has 3000 employees worldwide.

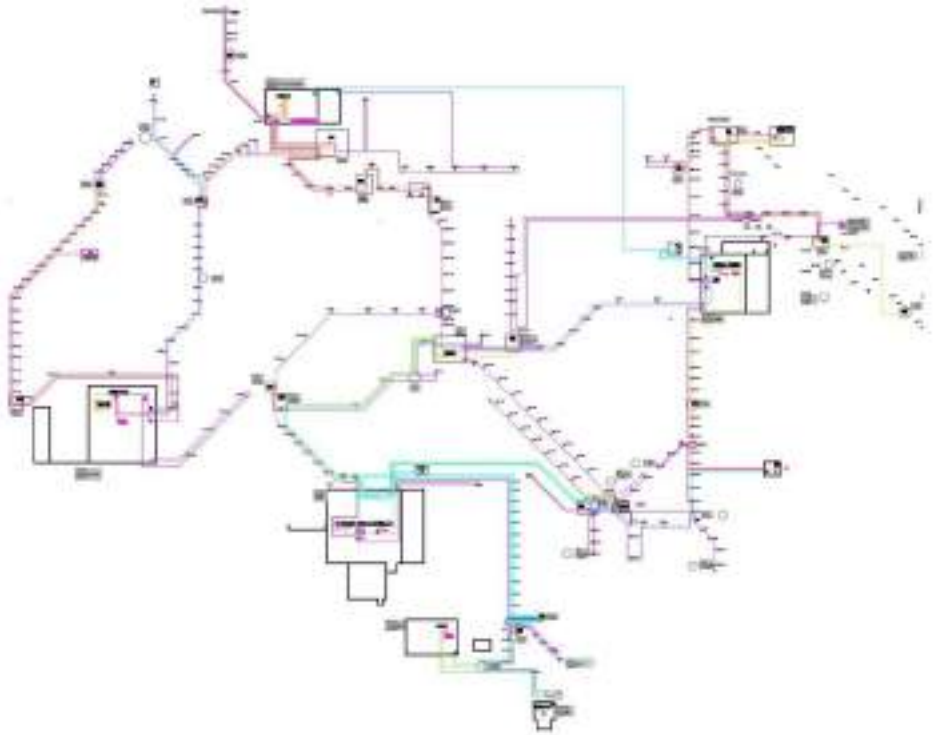
The St. Moritz – Engadin Project

The "St.Moritz Engdain Mountains" consortium manages a vast area of ski slopes with restaurants, ropeway systems and snow generator systems in the captivating region of St. Moritz, in the Engadina Valley in Switzerland, one of the most famous tourist spots in the world. Chique, elegant and

exclusive, St. Moritz is encapsulated within a cosmopolitan environment located at 1856 m s.l.m. in the middle of the Upper Engadina lake landscape. Today 5,400 people reside in St. Moritz and during the high tourist season it attracts an additional workforce of 3000. There are also more than 40 traditional hotels with accommodation for 5300 guests. Privately owned holiday homes accommodate a further 7500 of which 3500 are rented out. Fifty per cent of the accommodation provided in St. Moritz belongs to four and five star hotels. St. Moritz is also the location where Winter Alpine tourism began (1864). It is also the place where the Alpine sports were established in1884. The played host to the 1928 and 1948 Winter Olympic Games and many world ski and ski bob championships.

One of the ski lift stations used to reach the top of the St. Moritz – Celerina ski resort pistes.

The "St. Moritz Engdain Mountains" consortium needed to modernize and unify all the ski resort snow generator management systems on both the North and West ski slopes. The West ski slope has a snow making system installed in the 90's by DEMA (now DEMACLENKO) which provides a series of 250 underground wells for storing the artificial snow with 6 connected pumping stations which supply water at 1800 to 2900 meters above sea level. The total power generating capacity installed is 7 MWatt.



The complex network architecture of the entire ski resort using optic fiber.

The system used on the North slope was also installed in the 90's by a company called SUFAG. It has 200 wells and 3 pumping stations with a power generating capacity of 4 MWatt.

The unification project focused on optimizing system management by creating one unique monitoring and control system to improve operability efficiency and optimize and reduce energy and water consumption.

The project engineering and deployment was commissioned to FREY AG, a company from

Stans, Switzerland, who sought collaboration with ELA Srl, a company from Laion (Bolzano), for their expertise and experience in projects such as this one. After carefully assessing various technology system architectures the Movicon 11.3 SCADA platform was chosen along with field Saia PLCs.
The Movicon Scada platform was specifically chosen for its project modularity that enabled the union of the two ski slope systems design engineered by two different companies. The North ski slope project was assigned to FREY AG, while the West ski slope project was assigned to ELA Srl.
Based on the Movicon project modularity, the projects were designed with Parent-Child architecture. The Parent project therefore disposes the resources of the various Child projects which remain independent and exist on their own. This enabled the Movicon project designed by FREY AG for the North slope and the Movicon project designed by ELA Srl for the West slope to unite in one 'Parent' project as one unique project while at the same time maintaining the two development teams and projects separate and independent. The architecture includes an unmanned server station located in the valley of Moritz-Signal. This station is connected in network, using optical fiber, to the client stations and various PLCs located throughout the ski slopes. The two remaining supervision stations are allocated at the mountain terminal stations and are operated by personnel from the Croviglia, Celerina, Trutz ski lift terminal stations and the main Signal Station. The Saia PLCs are connected in net to the central supervision station where there are 13 main control stations connected in Ethernet using optic fiber with a series of substations connected in a RS485 sub network using the Gateway Master technology betweem the Saia PLCs. The Movicon supervision uses its native 'Multiport' I/O driver for Saia which is capable of connecting to any Saia device with all available protocol including S-Bus.

System Requirements:

St. Moritz new ski slope supervision system's main task was to distribute control stations through one system with centralized and standardized management based on modern and popular user interface criteria. This was to be implemented with the purpose of re-modernizing the St. Moritz and Celerina control stations.
This would allow management staff to access any one of the functionalities within the system from any one of the control stations using the same interface. Furthermore, the continuously manned Corviglia control station, would assume the central role in managing the whole system.

One of the Movicon supervision system control station terminals at St. Moritz - Engadin

In addition to this, the supervision system had to ensure that the user authentication management remained centralized to allow new system users access to the system from any control station terminal using the web as well.
All these requirements were taken into full consideration when evaluating which Scada platform to adopt as well as the capacity to be managed by the two different developer teams: FREY AG and ELA Srl. The choice of using the Movicon technology resulted successful by satisfying the fundamental

requirements due to its expandability and design engineering modularity. It must also be recognized that the project had to be predisposed for integrating with the ropeway system management. In addition the design engineers were given little time to complete the project. This was due to the fact that the short summer period at high altitude meant that they had to work fast to design, install and get the system up and running before the winter season set in.
However, this did not hinder the engineers who were able to complete work in time and with success to the great satisfaction of the clients and co-operation of the different company developer teams, the potentiality of the Movicon platform and the Progea technical support services. The new supervision system now enables the client to start producing artificial snow from as early as October. This means that they can completely cover the slopes with artificial snow in time for the Christmas holiday season before the freezing temperatures of December set in.

The main system functionalities:

The Movicon supervision system manages a total of 4,500 variables, organized in data structures to enable smooth system parameterization, making data easier to manage in the PLC and organize in the supervisor. The various modular projects can be accessed from the various area workstation terminals spread throughout the North and West ski slopes. The main functions of the supervision system are:

Pumping Stations:
The Movicon supervision system enables the complete management of the pumping stations using parameterized screen page interfaces to quicken repetitive function programming and drastically reduce risk of errors. All the pumps of each station are completely controlled individually using manual and automatic commands. The functional parameter definitions are recorded in appropriated databases to ensure traceability and data protection. Purposely defined algorithms enable energy consumption optimization that can be analyzed statistically in detailed reports.

Snow generators:
Artificial snow is produced completely in automatic using the snow generator management system defined also as snow cannons. Maps of the whole skiing resort complex are managed on screen on the

supervisor side so that the existing 150 generators can be easily localized and configured. These generators can also be dismantled by hand and repositioned where required. The supervisor uses an ingenious parameterization system, which was developed using the ELA Srl technical know-how, which enables configurations to be read from the field. It also allows each generator to be displayed with its status on screen maps. The area map layout on screen shows the location and status of each generator so that they can be individually analyzed in detail. The parameterized page contains all the information about the machine processes (startup, alarms, shutdown, production, etc.)

and retrieved measure values (air temperature, corona discharge, water, humidity, water pressure, wind speed and direction, etc.).
An interesting feature to note is that any one of the generators can be physically positioned and reconnected in any part of the ski resort complex without needing any program modification. By using just the one command, the supervisor updates the configuration to point to the specified addresses even when physically present in different PLCs. This is made possible by the "Hot" driver's capacity to automatically reconfigure.

Historical logging and Analysing:
Each individual snow generator records all the process information on a relational database based on SQL Server, using the native Movicon data logger tools. For example, the measure values include air temperature and wet bulb, air humidity and efficiency. All consumptions are historically logged, such as duration of time in service divided by temperature ranges, water consumption and energy consumption. This enables partial or total consumptions to be consulted by filtering them by period and other filter selection types.
Reports and Trends using the powerful Movicon analytic tools are also used for presenting recorded data in various graphical charts according to selected period.
The pumping stations are also managed in the same way by recording process data, value behavior such as water level, input and output pressure and flow values and more.

Alarm Managment:
The supervision system collects and centralizes alarm data from modular projects (child) so that it can be distributed to the various workstations for viewing diagnostics both as realtime events and recorded events. The system manages a total of 3,800 alarms divided by area and severity. By using the Movicon diagnostic system and functions, staff can easily manage the snow generation under all circumstances in response to the information displayed by the system on screen. The efficient alarm management enables maintenance and service staff to intervene with preventive or corrective procedures immediately and obtain complete control of the whole system from any position throughout the entire ski resort complex. In addition, Movicon manages notification of events with SMS, Email or Voice mail to enable quick intervention by on-call duty staff in certain situations when the different areas are left unmanned.

User and Password Management:
The supervisory system handles all modular (child) and parent project users in a centralized management. Movicon enables the various projects, whether modular or client-server architecture, a continuous synchronized user profile management. It can also be used for those users inserted by clients during runtime mode. The system defines seven user levels (1024 can be defined with Movicon) and an administration level to allow access to certain system commands according to user responsibility status.

Web Client and Terminal Server:
The supervisory system offers the use of a management within its architecture to handle different client stations using the Windows Terminal Server function when the client station is connected in LAN with the ski resort complex's local network. Even though momentarily not in use, Movicon is predisposed with a Movicon Web Client feature which enables staff to access the system through the web by iPhone, iPad or mobile device with any browser.

Benefits and conclusions

As previously mentioned, the entire system went into action on schedule to the great satisfaction of clients who observed the effectiveness of greater system usability and integration from the first season running. They were also able to benefit by optimizing costs and system performances.

The Clients have demonstrated their satisfaction by planning to use the supervision system to manage the ropeway system which also constitutes a major role in running the world famous St. Moritz ski resort.

We would like to thank Mr Helmut Lardschneider and Alfi Piazza from Ela Srl