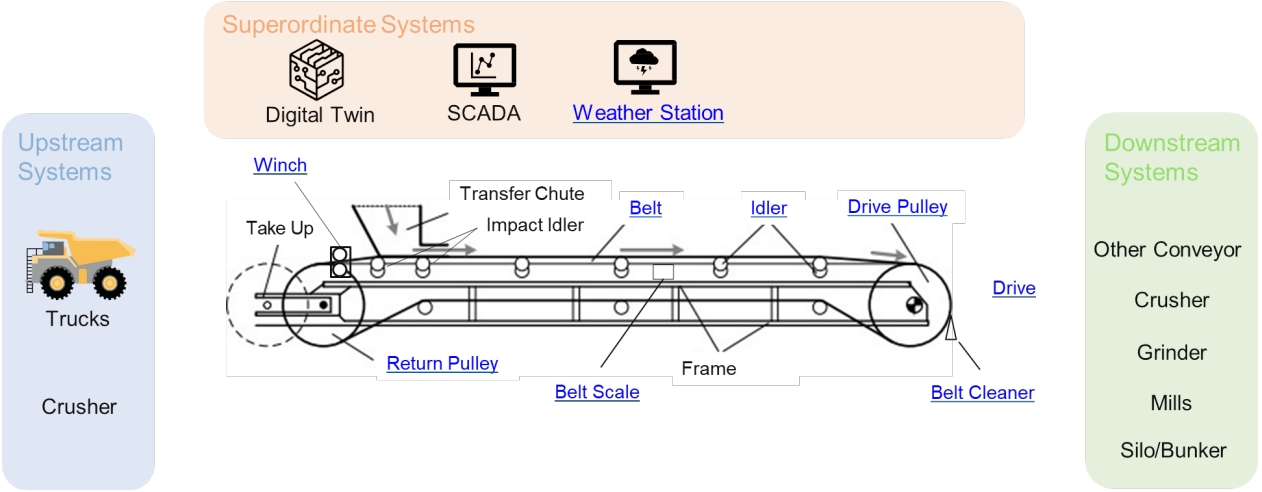
Use Case Compilation

Specialist group Conveying



The use cases developed in the specialist group were prioritized in such a way that the use cases with priority 1 are planned for the first publication. These use cases represent the basic functions for conveyor belt systems.

The use cases with priority 2 will then be processed further in the next step.

Priority 1	Priority 2
# 3 Control of the brakes	# 1 Control of pulley´s bearing lubrication
#5 Startup procedure	# 2 Pulley utilization time
#6 Loadsharing	# 4 Misalignment detection
#7 Scheduled shutdown	# 8 Drivetrain utilization time
# 14 Idler roller - Detection of defect roller // Roller Condition Monitoring	# 17 Bandfehler detektieren
# 20 Gurtlage spezifischer Reaktion des Abstreifer auf Gurtschieflauf	# 23 Betriebsparameter (KPI)
# 18 Startup process of a longer conveyor line	
# 19 Reinigungssystem an Reversierbändern mit automatisch ab klappbaren Abstreifer	
# 21 Age Information	
# 22 Belt Monitoring System	
# 25 Gurtüberwachung/Belt Monitoring System (new)	

Use Case # 1	Control of the pulley's bearing lubrication	Voith, Hr. Gladysiewiecz

Background

the pulley lubrication interval is dependent on the pulley load, belt speed, and the temperature. The insufficient lubrication is the main reason for bearing damage in conveyor pulleys.

Solution

the pulley gets following signals:

- Belt speed from Belt Sensor
- Mass Flow Rate from the Belt Scale
- Belt Tensile Force from the Belt Winch
- Ambient temperature from the Weather Stations.
- Bearing temperature from itself (sensors installed in the pulley's bearing housings)

Description

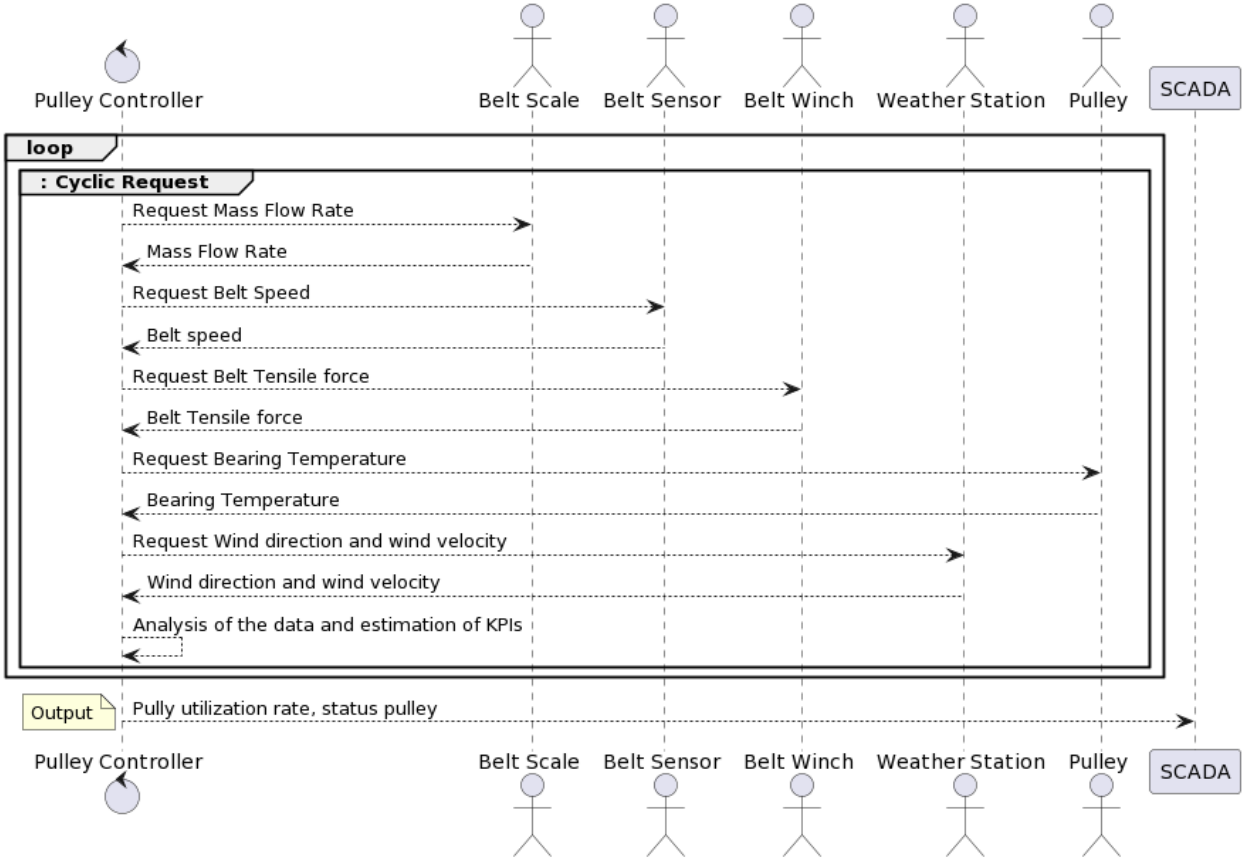
From the signals, the pulley controller calculates the grease service life and triggers the lubrication by the automatic lubrication system. The controller finds the optimal time for the lubrication, when the bearing is hot and rotating. From the difference between the ambient temperature and the bearing temperature, the controller can estimate if the bearing is full with grease.

If there is no automatic lubrication, system the controller can send the message "lubrication necessary" to SCADA.

The digital twin can overtake the function of the controller.

Abgestimmt: Sitzung **Prio 2**	**Datum:** 31.10.2023

Use Case # 1 "Control of the pulley's bearing lubrication"



Status: 18.01.2024

Use Case # 2	Pulley utilization time	Voith Herr Gladysiewiecz

Background

The pulley utilization time is important information for the customer, till now there is no tool showing it. The pulley utilization can be calculated knowing the load, speed, cleanliness level and the state of the belt.

Solution

the pulley gets following signals:

- Belt speed from Belt Sensor
- Mass Flow Rate from the Belt Scale
- Belt cleanliness level after cleaning Belt Cleaner System
- Belt wear rate of the belt from the Belt Sensor
- Bearing Temperature from the pulley
- Belt Tensile Force from the tension station

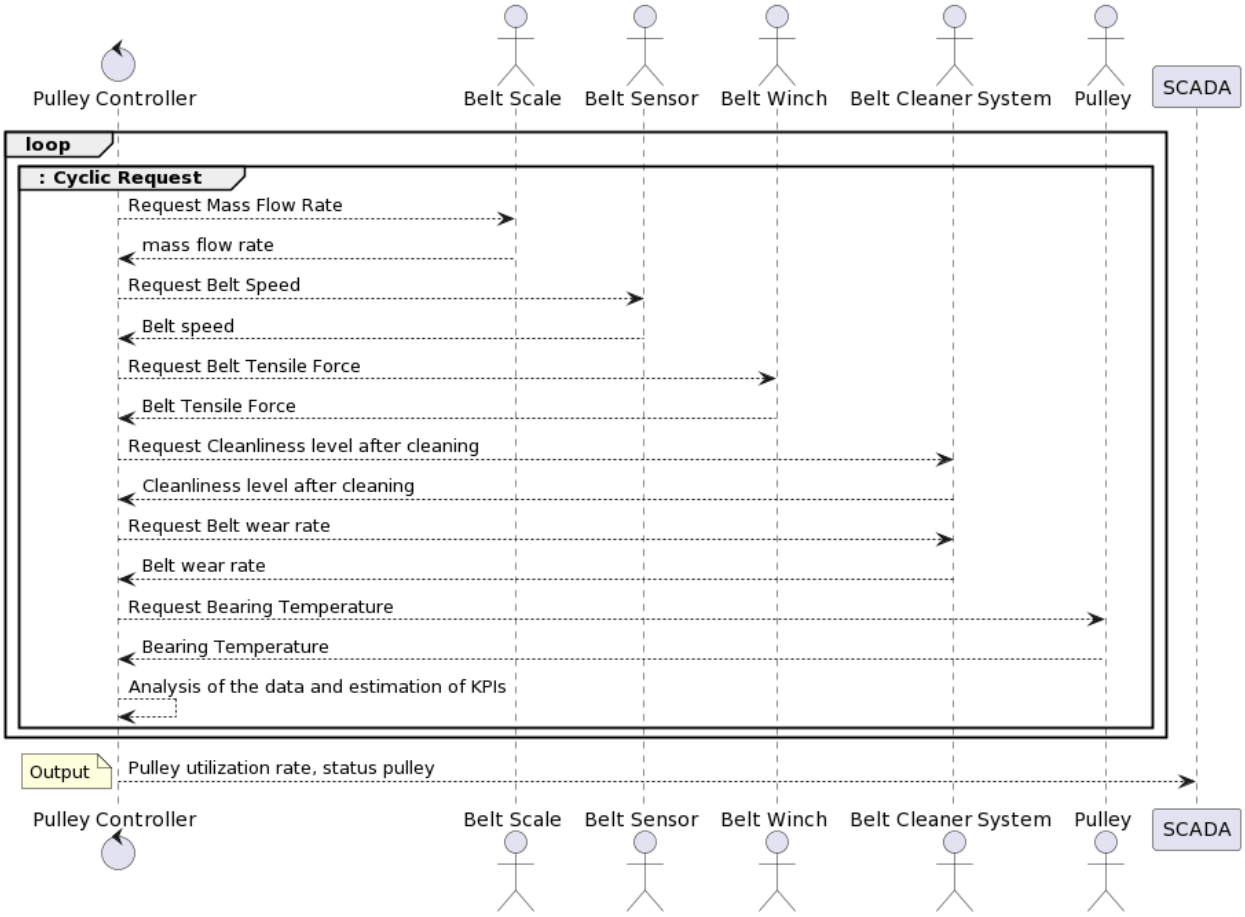
Description

From the signals, the pulley controller calculates the utilization time of the pulley, the bearing service life and the wear of the lagging.

The digital twin can overtake the function of the controller

Abgestimmt: Sitzung **Prio 2**	**Datum:** 31.10.2023

Use Case # 2 "Pulley utilization time"



Status: 18.01.2024

Use Case # 3 **# 9 gelöscht! und # 10**	**Control of the brakes**	Voith, Herr Gladysiewicz

Background

This is the state of the art and no new case. However, it shows how different equipment communicates with each other.

Solution

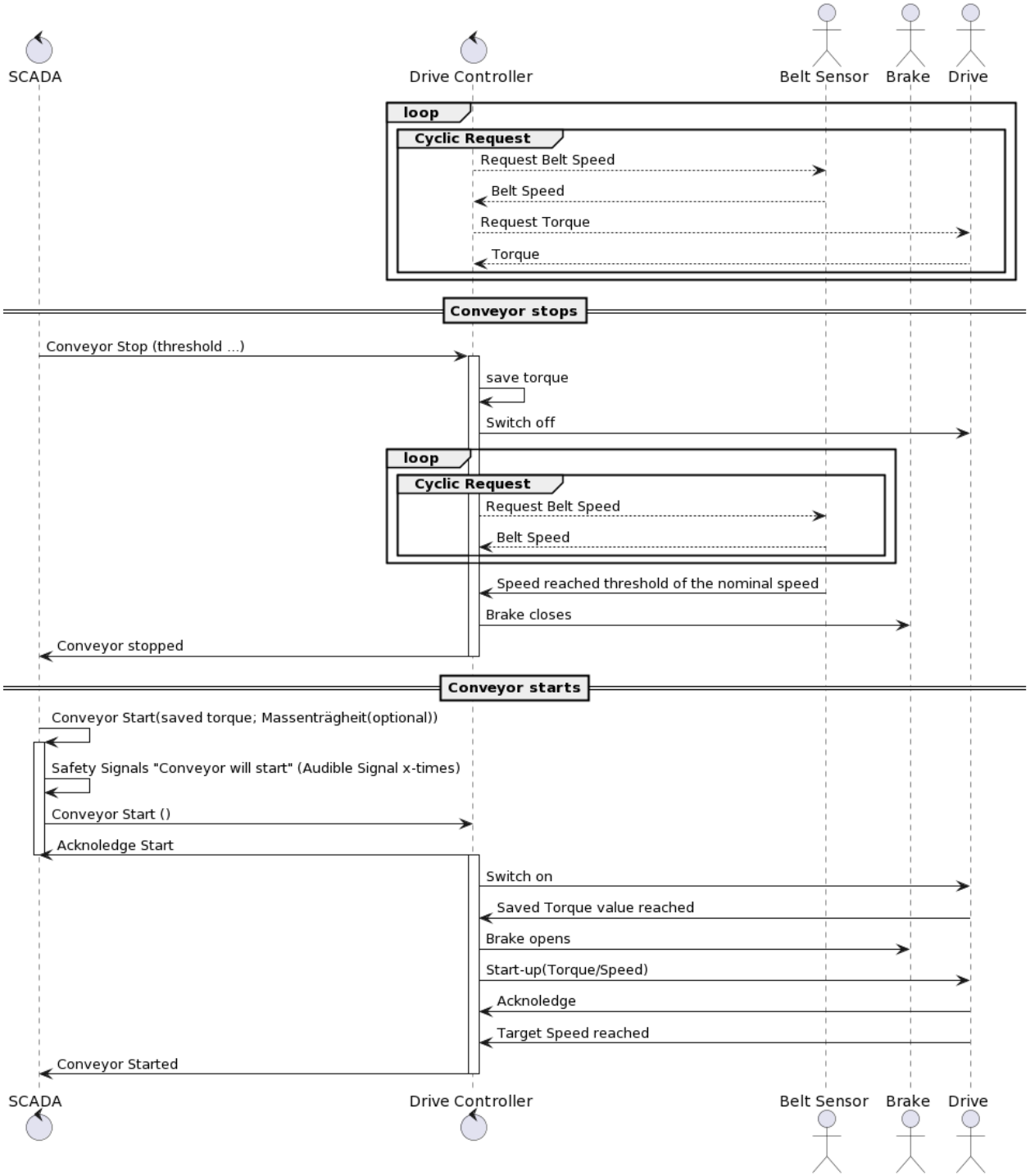
- Belt Speed from the (Belt Sensor)
- Torque from the Drive
- Threshold
- Conveyor Stop (Threshold,…) from SCADA
- Conveyor Stopped from Drive
- Switch Off from Drive Controller
- Brakes Closed from Drive Controller
- Speed reached threshold of nominal speed Belt Sensor
- Conveyor Stopped from Drive Controller
- Conveyor Start (saved Torque, Massenträgheit (optional)…) from SCADA
- Safety Signals from SCADA
- Conveyor Start (..) from SCADA
- Acknowledge Start from Drive Controller
- Switch On from Drive Controller
- Brake Opens from Drive Controller
- Start Up (Torque/Speed) from Drive Controller
- Acknowledge from Drive
- Target Speed Reached from Drive
- Conveyor Started from Drive Controller

Description

In this use case, the conveyor system can be equipped with 1 drive or brake as well as with several drives or brakes. For this use case it could be that In the uphill conveyors, the brakes have the function of backstops. In the running conveyor, the controller gets the actual torque of each drive. During stopping, the last drive torque is saved and the motors are switched off, conveyor stops and the brakes are closed when the belt speed reaches about 5% of the nominal speed. During start up, the motors are switched on the brakes stay closed. When the torque reaches the last saved value, the brakes are opened and the conveyor starts.

Abgestimmt: Sitzung **Prio 1**	**Datum:** 31.10.2023

Use Case # 3 "Control of the brakes"



18.01.2024

„Conveyor Drive“

Here we have to differentiate between uncontrolled and controlled drives. As a rule of thumb, one can say: the longer the start-up time and the more drives a conveyor system has, the higher the requirements for drive control.

Uncontrolled Drives

Uncontrolled means that the drive can only be switched on or off and the behavior of the system then only depends on the current status of the system (mainly the load). For uncontrolled drives, which are used in particular in smaller belt conveyors with only one drive, only information about switching on or off is required. This is implemented as standard in the controls of the conveyor systems, so that no new data calls are required for uncontrolled drives in connection with the specification for OPC UA Mining Conveying.

Controlled Drives

Controlled means that the drive torque can be actively adjusted to the value required for the respective operating state. The control can be achieved electrically via the motor (frequency converter, slip ring rotor with continuously or stepwise variable series resistors) or mechanically via a variable torque transmission between the motor and gearbox (mainly through hydrodynamic couplings with a variable degree of filling, i.e. fill controlled turbo couplings).

There are three different operating states to consider, for each of which a use case is described:

- Startup procedure
- Stationary operation
- Shut down procedure

The use cases described below relate exclusively to controlled drives.

Use Case # 5	**Startup procedure**	Voith Herr Ziegler
<u>Background</u>		
The belt conveyor should start as gently as possible in order to avoid unfavorable dynamics of the belt tension. Belt forces that are either too large or too small are unfavorable. Too high belt forces mean: • The belt falls below the specified security against breakage • Overloading of the pulleys • Overloading of the idler rollers in convex vertical curves • Lifting the belt in concave vertical curves → Unloading of conveyed material due to loss of the trough Too low belt forces mean:		

- Excessive belt sag between the idler roller stations → Longitudinal vibration of the belt can cause the idler rollers to move out of position when the local belt tensile force suddenly increases again
- Too little belt pre-tension on the drive pulleys → risk of slipping

Solution

The dynamic behavior of the belt conveyor can be simulated in advance for all loading situations. This means that the ideal torque curve can be determined to achieve an even distribution of the belt forces. So that the control can regulate the drive torque to the desired value, it needs the following measured values and information:

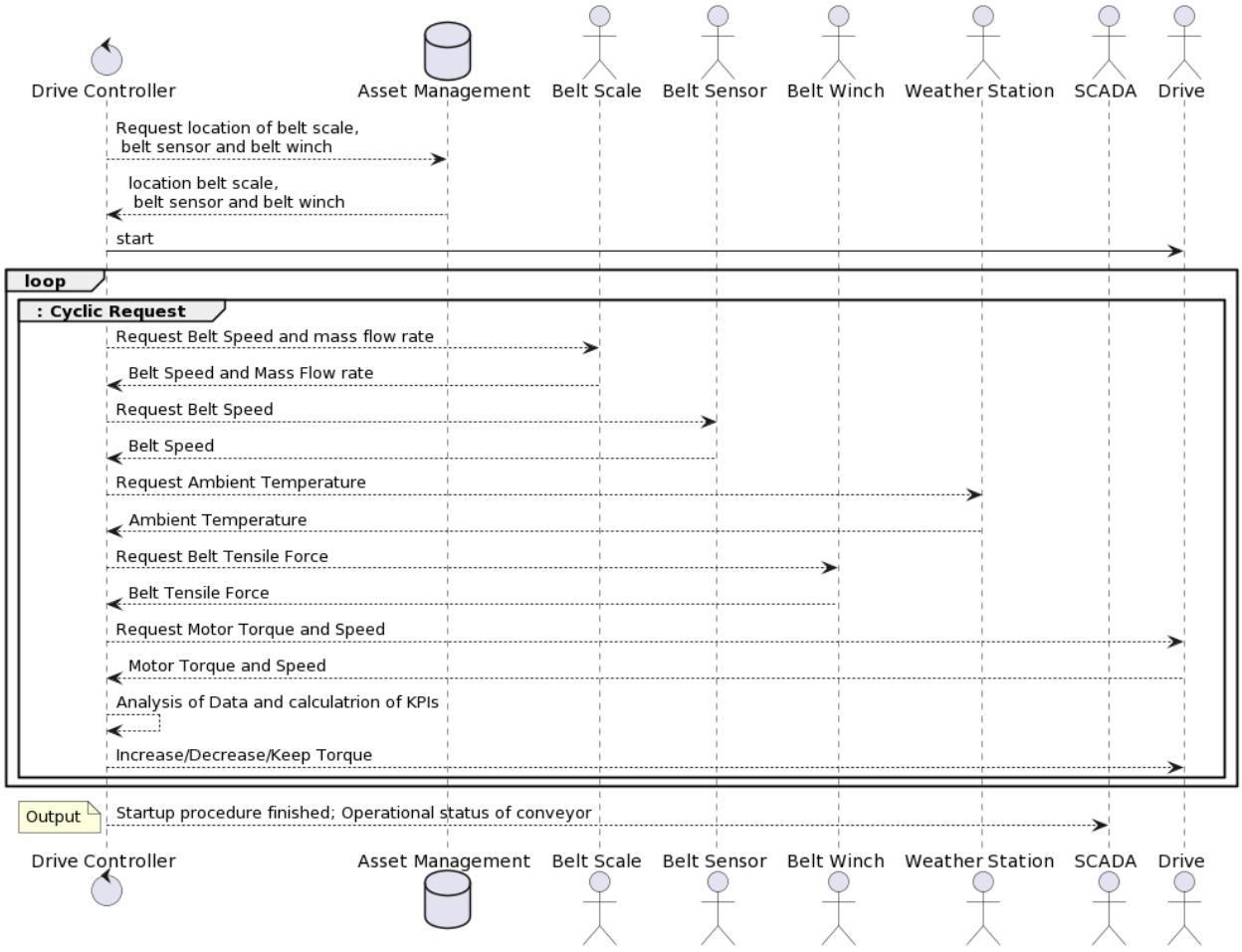
- Mass Flow (Mass Flow Rate) [t/h]
- Signal and location of the belt scale (Belt scale location)
- Belt speed and location of measurement (Belt Sensor location)
- Belt Tensile Force and location of measurement, or (in the case of weight pre-tension) location of the tensioning device (Belt tension station location) (Location Belt Winch)
- Power of the motors (Torque and motor speed or motor current)
- Ambient temperature (Temperature(s))
- Downtime (internal value determined by the drive controller itself)

Description

According to the implemented logic of the drive controller, it determines from the measured values the target torque of the motor resp. whether and how the degree of filling of the hydrodynamic coupling needs to be adjusted.

Abgestimmt: Sitzung **Prio 1**	**Datum:** 2024-01-18

Use Case # 5 "Startup procedure"



18.01.2024

Use Case # 6	Loadsharing	Voith Hr. Ziegler

Background

If the belt conveyor has several drives, each of the drives should deliver a specified proportion of the required drive power. In most cases, all drives should deliver the same proportion (e.g. 50% each for two drives), but other distributions are also possible and may be necessary. A deviation from the ideal distribution leads to individual drives working with higher loads (premature wear) and the maximum possible delivery capacity being reduced, as the drive with the highest load share can trigger an overload shutdown, even though the other drives still have reserves.

Solution

During stationary operation - i.e. the starting process is complete - the drive controller regulates the power of all motors. For the control to work well, the time behavior of the belt system and the drives must be taken into account. The following information is required to determine Nominal belt speed

- Nominal mass flow rate
- Location of the drives

Once the controller parameters are known, the following measured values are needed:

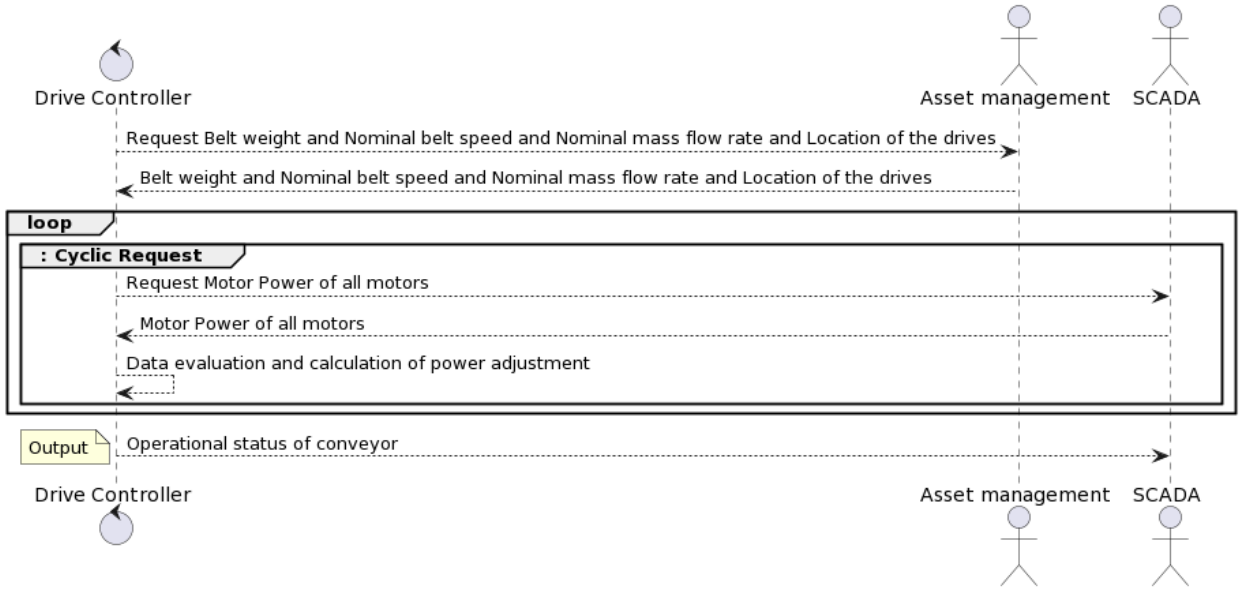
- Power of the motors (Torque and motor speed or motor current)

Description

According to the implemented logic of the drive controller, it determines from the measured values the target power for each motor resp. whether and how the degree of filling of the hydrodynamic couplings needs to be adjusted.

Abgestimmt: Meeting **Prio 1**	**Datum:** 2024-01-18

Use Case # 6 "Load Sharing"



Use Case # 7	Scheduled shutdown	Voith Herr Ziegler

Background

The belt conveyor must be stopped safely for all loading conditions within a specified time frame (typically 20 to 30 seconds). After this, no unguided movement – running backwards on a conveyor with uphill sections, or forwards on a conveyor with downhill sections – is allowed to take place. The holding torque required for this can vary in terms of size and sign, particularly in systems with both uphill and downhill sections. Backstops - sometimes without brakes at all - are often used in belt conveyors that only require a holding torque to prevent them from running backwards.

Unfavorable dynamics of the belt forces must also be avoided in the transition period from stationary operation to standstill. The conveyor belt acts like a spring that stores energy depending on the current distribution of tension, the length and the elastic modulus of the belt. Particularly on long belt conveyors, switching off the motors can induce longitudinal belt vibration, which leads to impermissibly high or low belt forces.

If the conveyor demands positive motor power, the motor torque must be reduced so that the belt speed decreases to zero within the specified braking time. Systems with a low gradient have a low self-braking behavior, i.e. the unbraked stopping time can be longer than the desired braking time. In these cases, active braking torque is required. This can be generated by a negative motor torque or by a mechanical, controlled brake.

In regenerative operation (downhill conveyor with a correspondingly high inclination and load), the regenerative (i.e. negative) motor torque must be increased accordingly or a mechanical brake must intervene as quickly as possible when the motors are switched off.

Solution

During motor braking, the drive controller requires the following measured values:

- Belt Speed
- Mass flow rate

An improvement in control can be achieved if the following measured values or information are taken into account:

- Signal and location of the belt scale and belt sensor

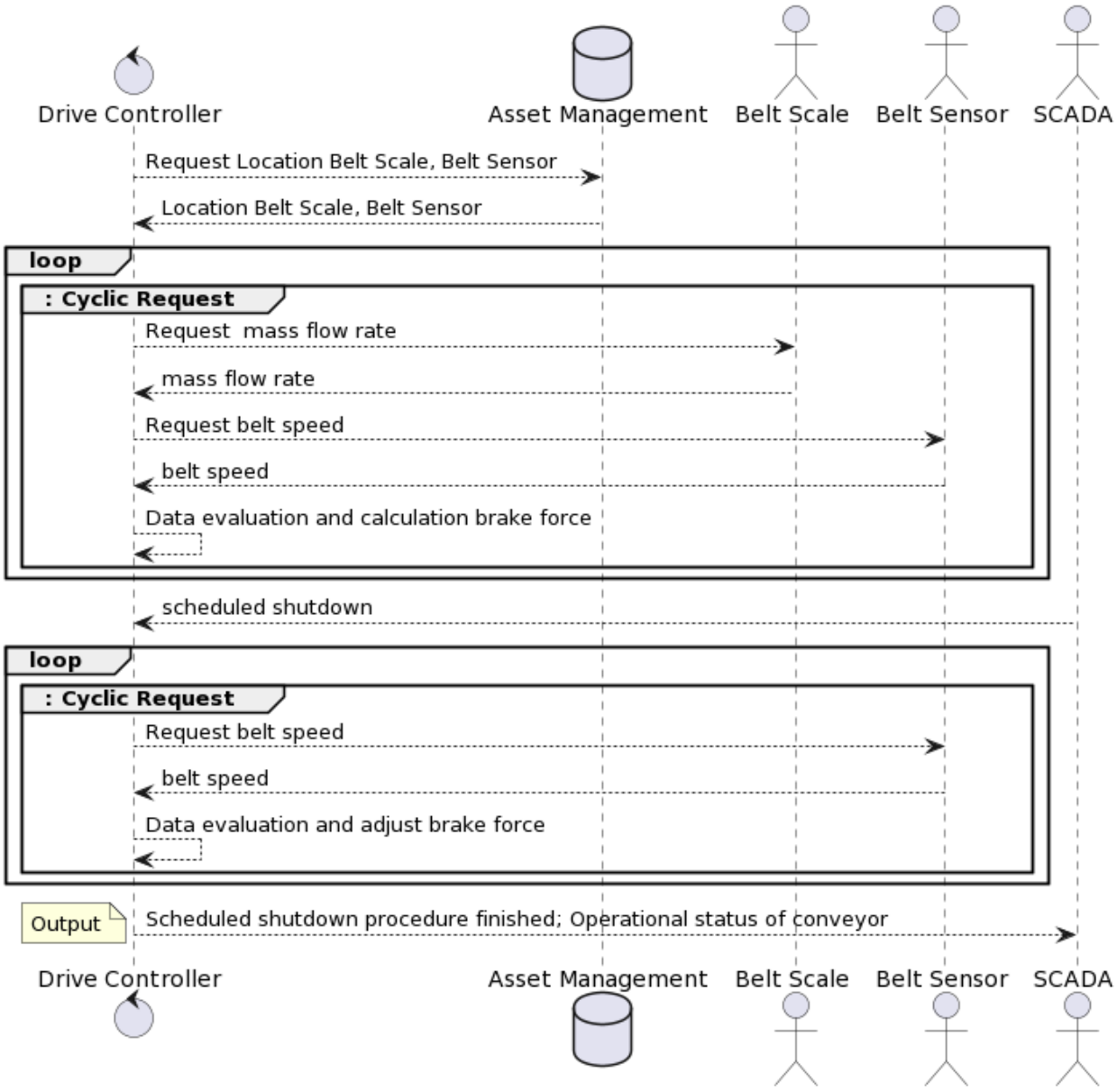
Description

During operation, the drive controller receives the signals from the belt scale and continually calculates the total load on the belt as well as the resulting kinetic energy of the moving masses. From the kinetic energy and the current motor power, the drive controller constantly calculates the driving or braking force required in order to maintain a specified braking time.

If a scheduled shutdown is initiated, the drive controller changes the current motor power to the drive or braking power calculated to comply with the specified braking time. During braking, the drive controller compares the current belt speed with the desired speed ramp and adjusts the motor power accordingly.

Abgestimmt: Meeting **Prio 1**	**Datum: 2024-01-18**

Use Case 7 "Scheduled shutdown"



18.01.2024

Use Case # 8	Drivetrain utilization time	Voith Herr Ziegler

Background

The expected service life of all components (motor, coupling, gearbox) of the drive train is important information for the operator. In order for this to be calculated, all influencing variables for the load spectrum that determines the service life must be taken into account.

Solution

The drive controller receives the following signals:

- Belt Speed
- Mass flow Rate
- Motor power
- Belt Tensile Force from the Belt Winch
- Weather conditions (air temperature (Temperature(s)), wind speed (Wind Velocity), precipitation (Precipitation)) from the weather station
-

Description

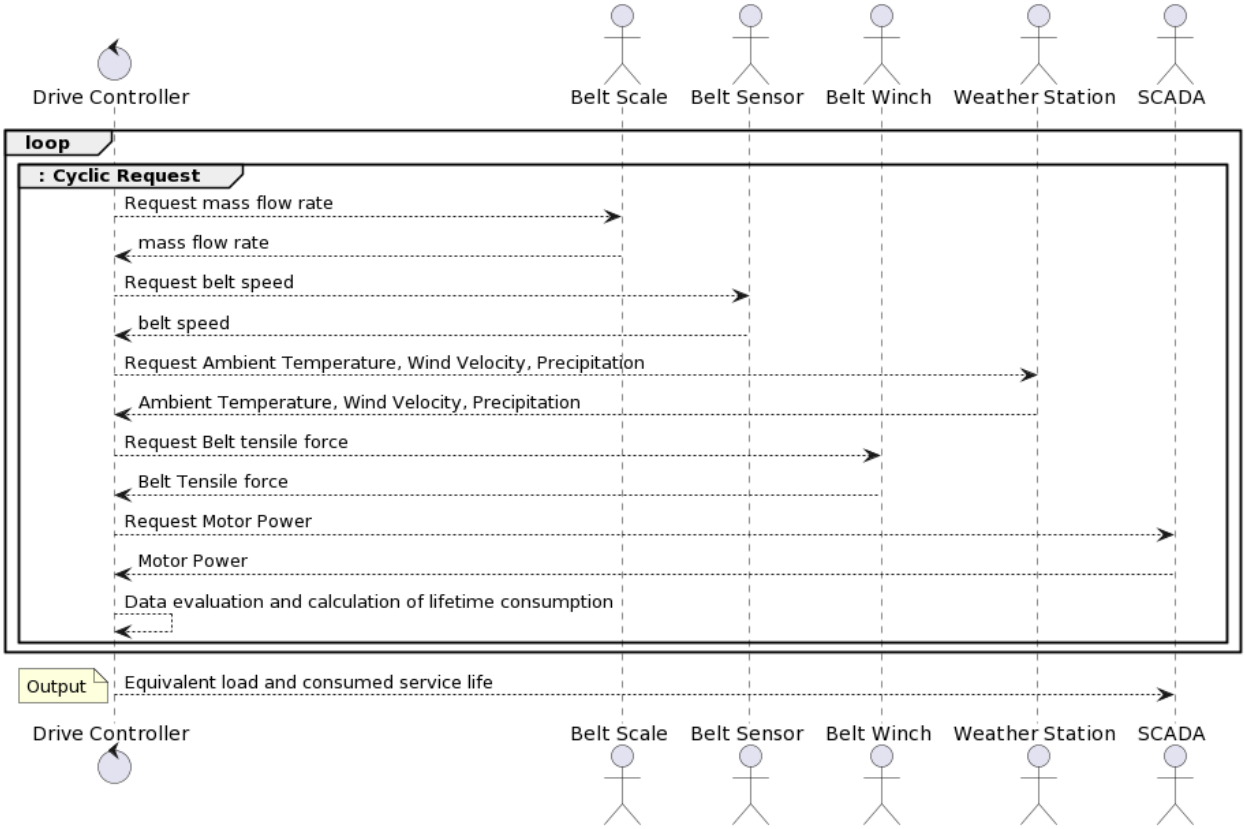
The drive controller uses these signals to calculate an equivalent load and the current service life consumption.

- Number of start-up/shutdown processes (internal value Drive Controller determines itself)

The digital twin can take over this task from the drive controller.

Abgestimmt: Meeting **Prio 2**	**Datum:** 2024-01-18

Use Case # 8 "Drivetrain Utilization"



18.01.2024

Use Case # 10	Release mechanic brake for startup	Voith Herr Ziegler

Background

Before starting, the brake is closed to avoid unwanted movements (moving forward or backward) of the belt conveyor. If there is a high holding torque and the brake is opened before the motor torque exceeds the holding torque, an unwanted acceleration of the associated pulley and drive occurs.

Solution

The brake control only releases the brake when the motor torque has reached a corresponding value. To do this, the brake control requires the following measured values:

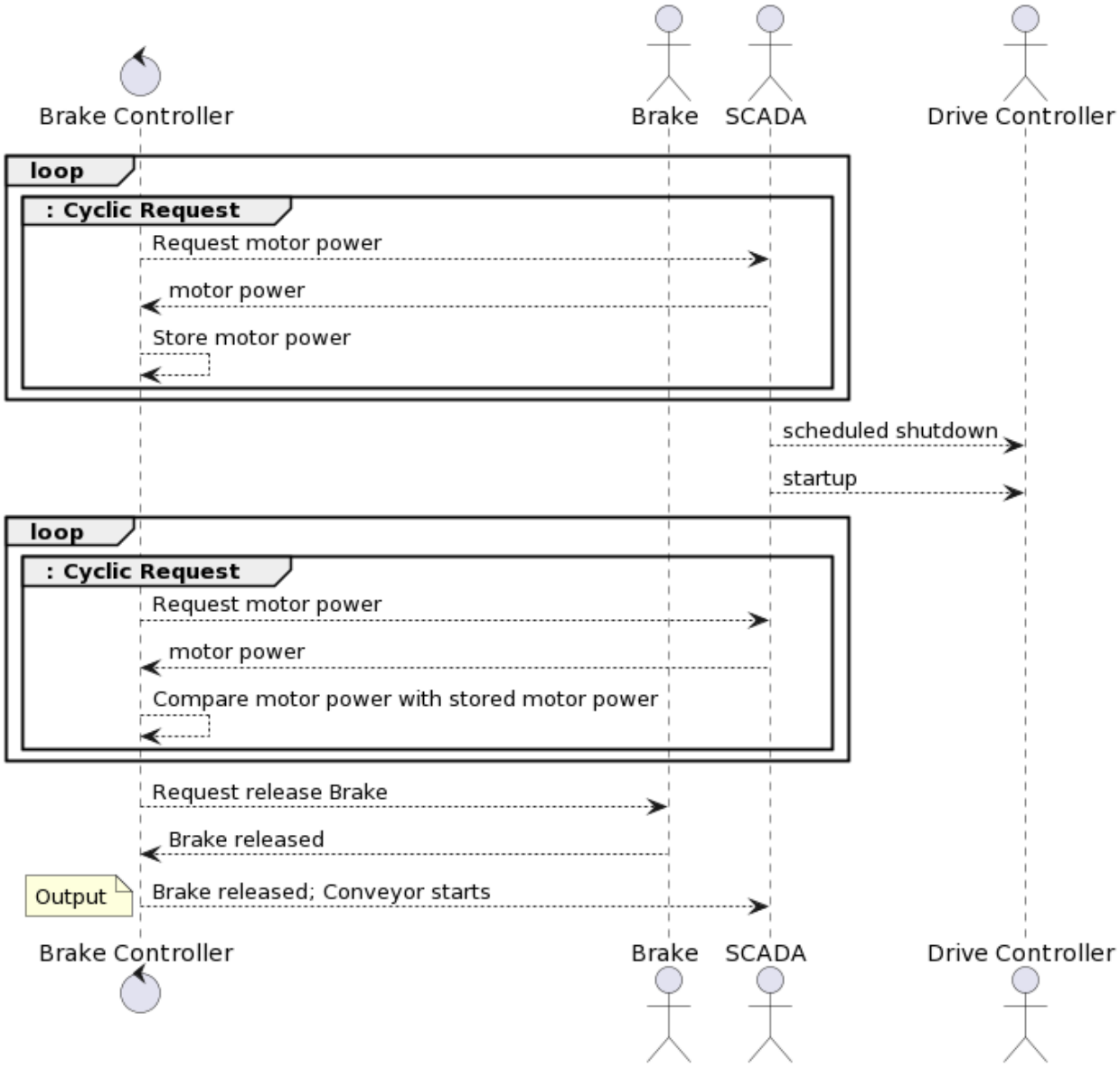
- Motor power at the time of shutdown (from Scada or internal Drive Controller value)
- Motor power (Motor Power)

Description

The brake has its own controller or the drive controller serves as brake control. It stores periodically the current motor power until it receives the stopping signal. During startup, it compares the current motor power with the sored last value and releases the brake as soon as the stred value is exceeded.

Abgestimmt: see # 3	**Datum:**

UseCase # 10 "Release mechanic brake for startup"



18.01.2024

Idler

Use Case # 14	Idler Roller - Detection of defect roller // Roller condition monitoring	Küpper Herr Chumachenko

Background

Defect roller can cause unplanned downtimes or even set the belt on fire. Defect roller cause in any case additional energy costs and increased wear of belt. One of main roller failure reasons is bearing failure. Reliable on time detection of defect roller is in many cases difficult or impossible to be done manually.

Solution

Using of automatic roller condition monitoring.

- Bearing Temperature from itself (sensors installed in the roller near to the bearing).
- Sensor or Sensor Node ID´s for part identification
- Database with connection of Sensor or Sensor Node ID´s to the defined installation places of rollers (traceability for each bearing place). Asset Management
- Rotation (sensors installed in the roller)
- Ambient temperature from the weather stations (option).
- Vibration (option)
- Belt speed from belt scale, drive or belt sensor (option)
- Nutzung von Process Values mit entsprechenden Limits und Methoden aufrufen!

Description

Using the information from temperature sensors as well as the installation position data in combination with an intelligent evaluation algorithm it is possible to get reliable statement about the condition of the roller: whether it is defect or not.

The information from rotation sensors can be used to detect blocked roller as well as to apply different evaluation rules to the roller, which are not rotating as they are temporary not in contact with belt.

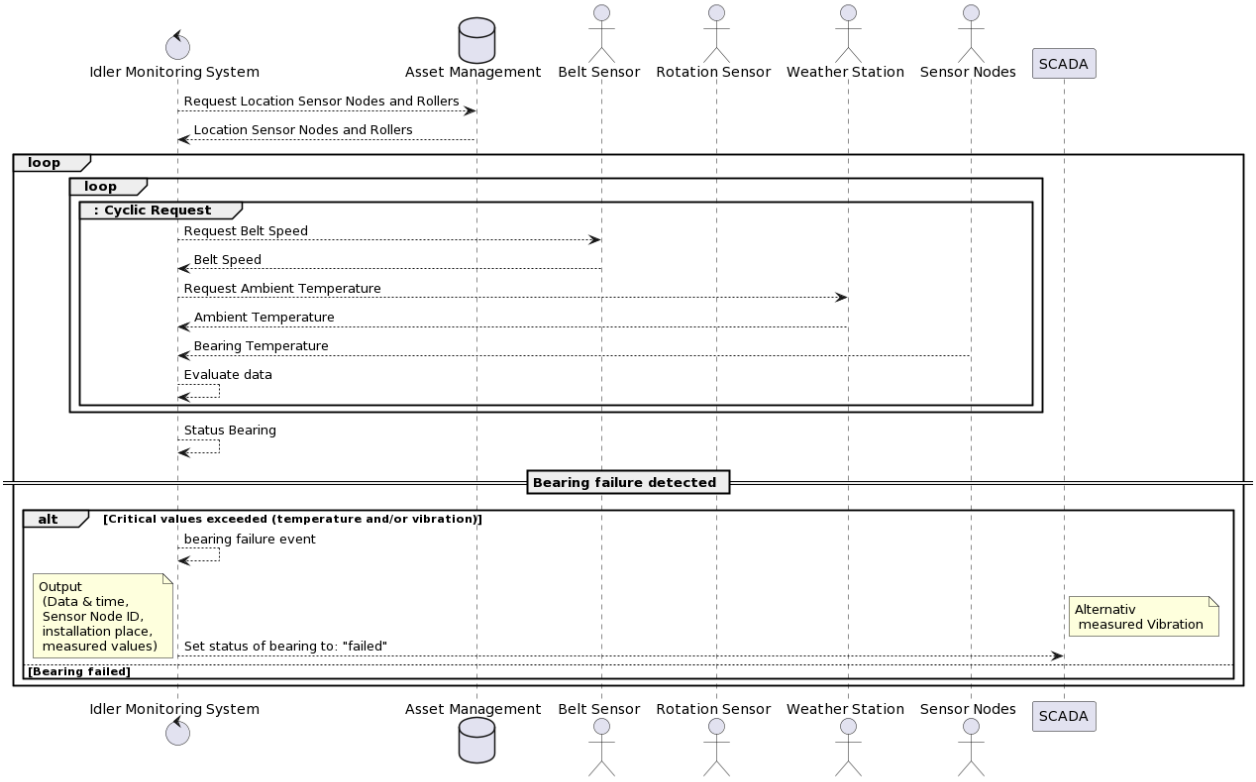
The information about ambient temperature can be used to verify the conclusion.

The data from vibration sensors can be evaluated to detect.

The corresponding alarm-messages with all relevant information (exact position, measured value, type of defect/deviation) can be generated and send to the conveyor operator (and/or to SCADA) together with handling recommendations (which kind of intervention). In most cases, the operator can change the defect roller during the next planned downtime.

Abgestimmt Prio 1	**Datum:** 14.06.2022

Use Case # 14 "Idler Condition Monitoring"



18.01.2024

Use Case # 15	Roller utilization time // Asset management (conveyor improvement)	Küpper Herr Chumachenko

Background

The information about utilization time of each kind of roller is very important to verify the design of the roller, improve the conveyor and increase the productivity reducing the shutdown times.

Solution

Using of automatic roller condition monitoring together with asset management functions.

- Bearing temperature from itself (sensors installed in the roller near to the bearing).
- Roller, Sensor and Sensor Node ID´s for exact part identification
- Database with connection of Sensor or Sensor Node ID´s to the defined installation places of rollers (traceability for each bearing place).Asset Management
- Rotation (sensors installed in the roller)
- Ambient temperature from the weather stations.
- Precipitation, Humidity from weather stations.
- Vibration (option) (Vibration)
- Belt speed from belt sensor or drive
- Belt Tensile Force from the belt winch
- Radial load (sensors installed in the roller = option)
- Maximum allowed radial load
- Capacity from the belt scale (Belt capacity)
- Cleanliness level of the belt from the Belt Cleaner System
- Target utilization time
- Warranty time Asset Management

Description

Using the information from all the listed sensors as well as the installation position data in combination with an intelligent evaluation algorithm it is possible to get reliable statement about the condition of the roller: whether it is defect or not.

Connection of the sensors with unique ID´s is marking the start of the utilization time.

An alarm message about the roller failure and the message about the disconnection of the sensors and replacement of the roller (other ID´s) is marking the end of the utilization time.

Taking into account the information about target utilization time and comparing this time with the estimated utilization time, can be decided whether any changes in design of roller, the idler frame or something else are necessary.

If the estimated utilization time is especially short (shorter than the warranty time), the decision about the claim case can be met.

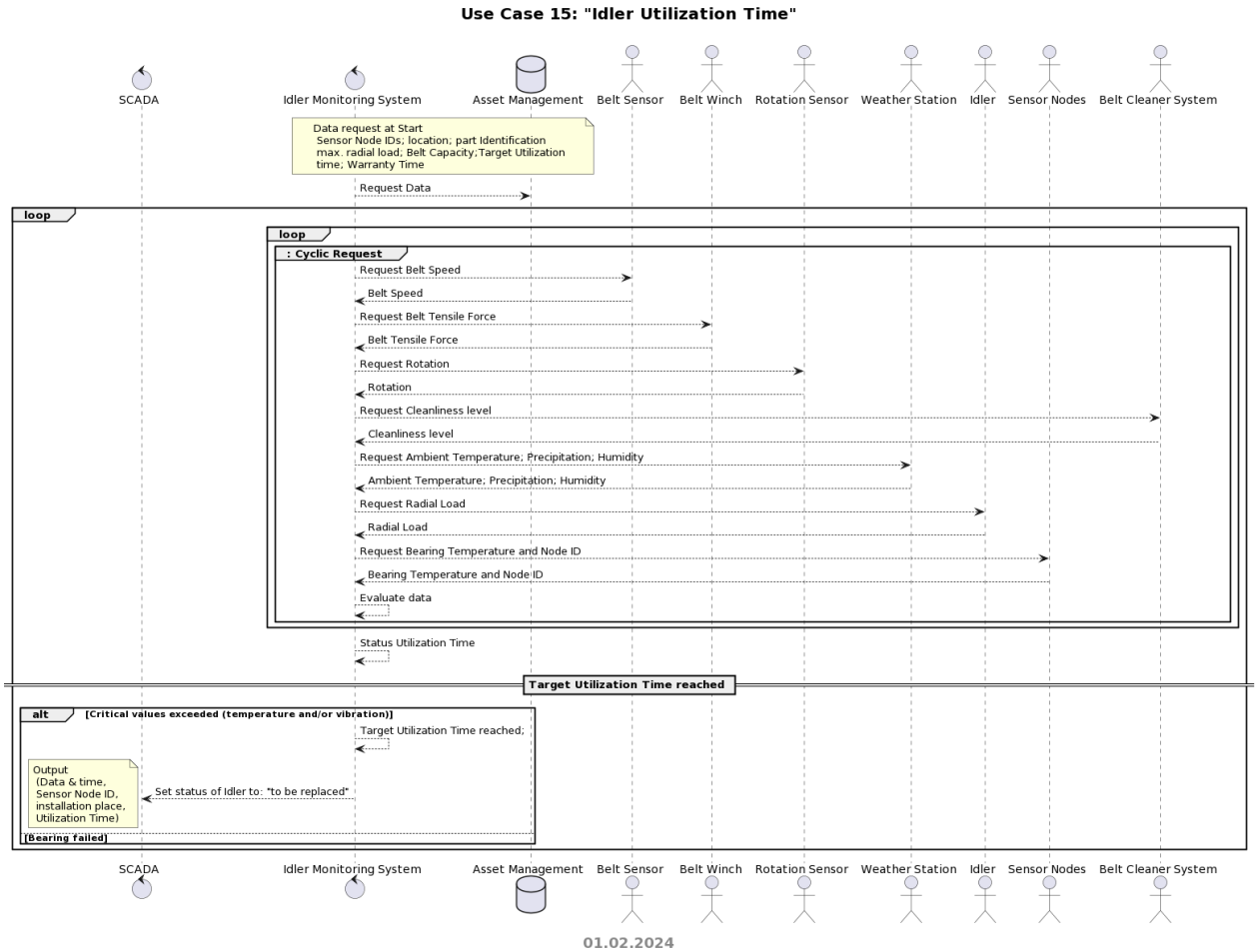
The rotation sensors can help to estimate the real working time of each roller (rotation counter & rotation speed).

The radial load can be estimated with data from belt scale and belt tension (e.g. for convex curves) to make sure, the maximum allowed radial load will be not exceeded (otherways alarm message to SCADA).

Using this data in addition with temperature data for each bearing, the calculation of expected bearing live (L10h / L10mh) will be possible. This can help to understand if constructive changes on the roller are necessary.

Is the main reason of roller failure the wear of roller tube or lugging? In this case, it can be checked if maybe some roller having too high rolling resistance: using the data from rotation sensor, belt speed data from the drive or the belt scale and the radial force sensors. Additionally the data from the scrapers can be taken into account to identify how many time the roller (especially of the return side) is running in contact with contaminated belt.

Abgestimmt: see # 14	**Datum:** 14.06.2022



Bandschieflauf

Use Case #4	Misalignment detection	Voith, Herr Gladysiewicz

Background

The misalignment of the belt can lead to huge damages and to material spillage.

Usually there are misalignment switches located in the head and in the tail of the conveyor, but in case of long conveyors the critical misalignment and the spillage can take place in the middle.

Solution

the controller gets following information:

- Temperature left and Temperature right from Idler
- Pulley Load left and right from Pulley
- Wind direction and Wind Velocity from weather station
- Mass Flow Rate from Belt Scale
- Status from misalignment sensors – warning / alarm or temperature in case of temperature based sensors. (Belt side deflection)
- In case of the load detection on the pulleys the load left/right for each pulley Kraftmessung auf der Trommel (Load)

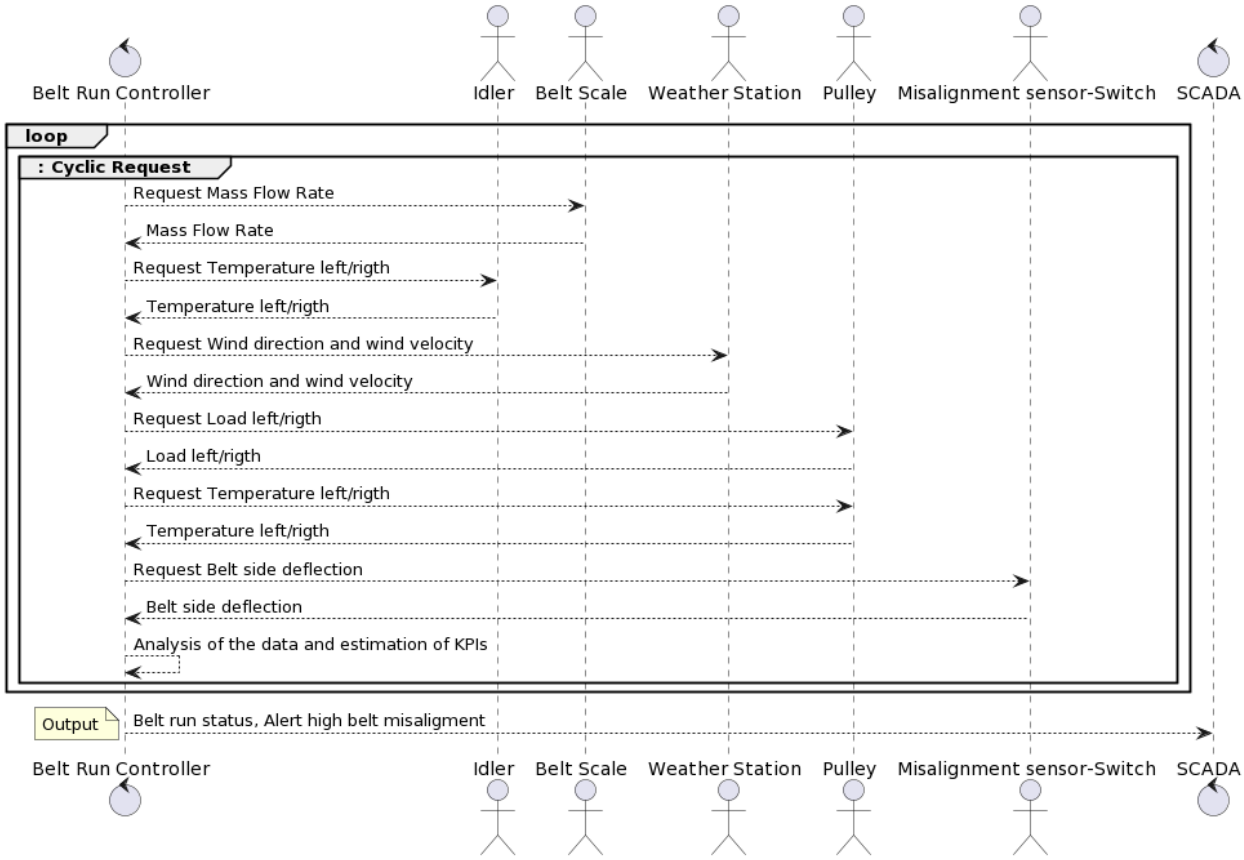
Output: Belt run status; Alert high belt misalignment

Description

In case of significant belt misalignment, the temperature on one side of the conveyor will be higher than on the other side. A controller can send a signal “warning misalignment in conveyor part X”. Comparing the wind speed, the capacity and misalignment rate, the reason of misalignment can be analyzed: When the misalignment increases with the increase of the capacity it can be stated, that the transfer point gives the material not in the middle, this information can be send to SCADA.

Abgestimmt: Sitzung **Prio 2**	**Datum:** 31.10.2023

Use Case # 4 "Misalignment detection"



01.02.2024

Use Case # 20	Gurtlage spezifischer Reaktion des Abstreifer auf **Gurtschieflauf**	Schulte Strathaus Herr Sudhoff

Background

Tritt aufgrund verschiedener Störeinflüsse Schieflauf am Gurtförderer auf kann dies zum Teil schwere Folgen für die Anlage und den ihren Betrieb bedeuten. Überschreitet der auftretende Schieflauf ein gewissen Schwellwert führt dies dazu, dass die federgelagerten Abstreifersegmente vom Gurt herunterlaufen. Infolgedessen können Schäden am Gurt und Reinigungssystem auftreten.

Solution

Um Gurt und Reinigungssystem vor Beschädigung zu schützen, schwenkt das Reinigungssystem vom Gurt ab, sobald der Schwellwert für den maximal zulässigen Schieflauf überschritten wird. Schieflauflage wird am Kopf der Anlage ermittelt

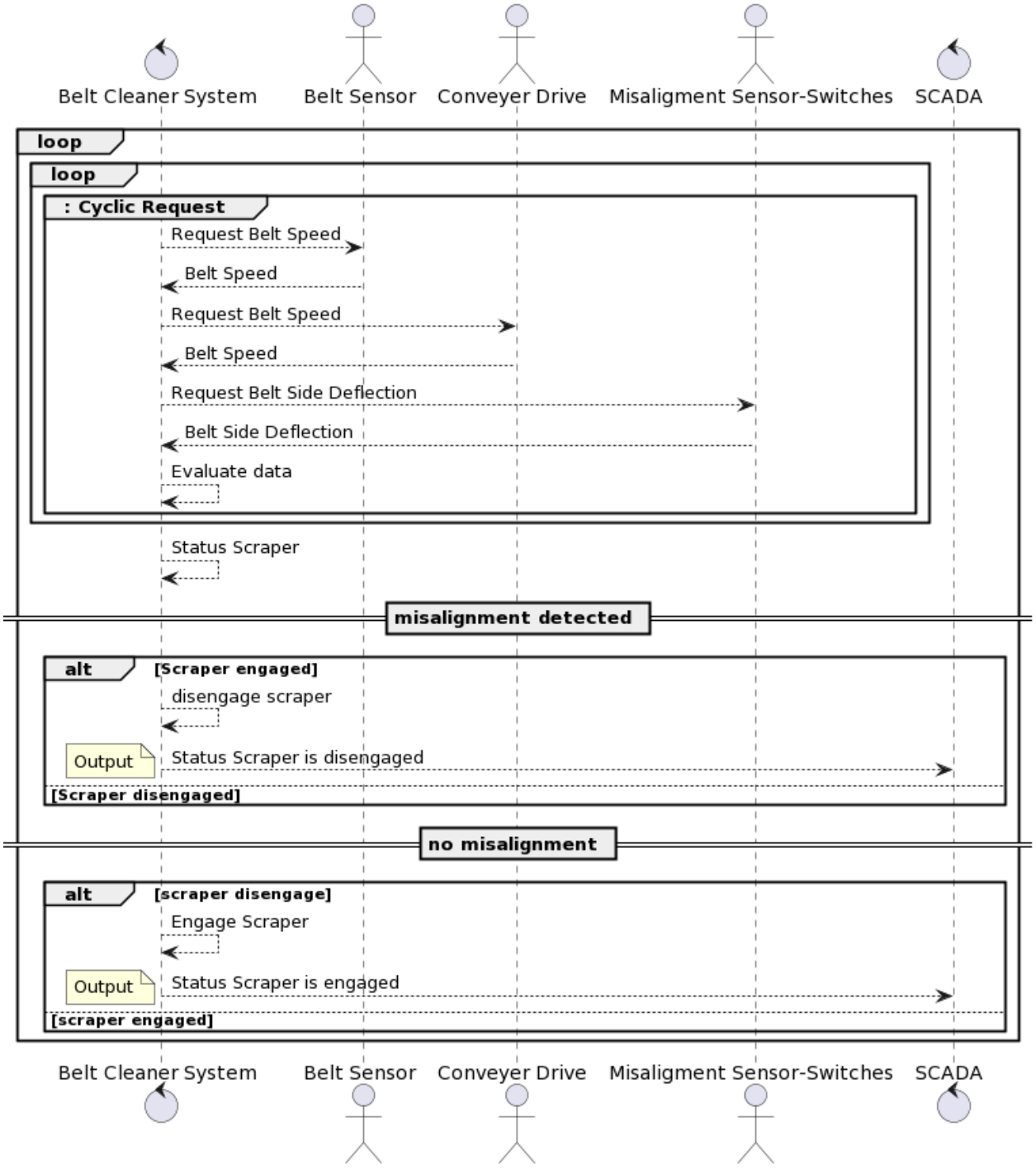
Benötigte Daten:

• Bandgeschwindigkeit (m/s)	Belt Sensor
• Bandgeschwindigkeit (m/s)	Conveyor Drive
• Schieflaufgrenzwert (mm)(Belt Side Deflection)	Misaligment Sensor Switch
• Rückmeldung zu Scrapper fehlt?	

Description

Abgestimmt: Sitzung **Prio 1**	**Datum:** 30.08.2022

Use Case # 20 "Gurtlage spezifischer Reaktion des Abstreifer auf Gurtschieflauf"



Use Case # 17	**Bandfehler detektieren**	Pfreundt Herr Holtermans

Background

Das Band der Bandanlage kann im laufenden Betrieb Schaden nehmen. Einige dieser Schäden verursachen beim Passieren der Bandwaage eindeutige Muster im Messsignal der Bandwaage. Diese Muster treten im Schadensfall zyklisch in Abhängigkeit der Bandlänge auf.

Solution

Die Bandwaage kann zur Detektion von Schadstellen im Band eingesetzt. Wenn die Bandwaage über mehrere Wägezellen verfügt, sollen die Messwerte der Wägezellen separat ausgegeben werden, diese Signale sollen mit der Information der Bandgeschwindigkeit und der Bandlänge gemeinsam ausgewertet werden. Wichtige Messgrößen zur Bestimmung eines Bandfehlers sind

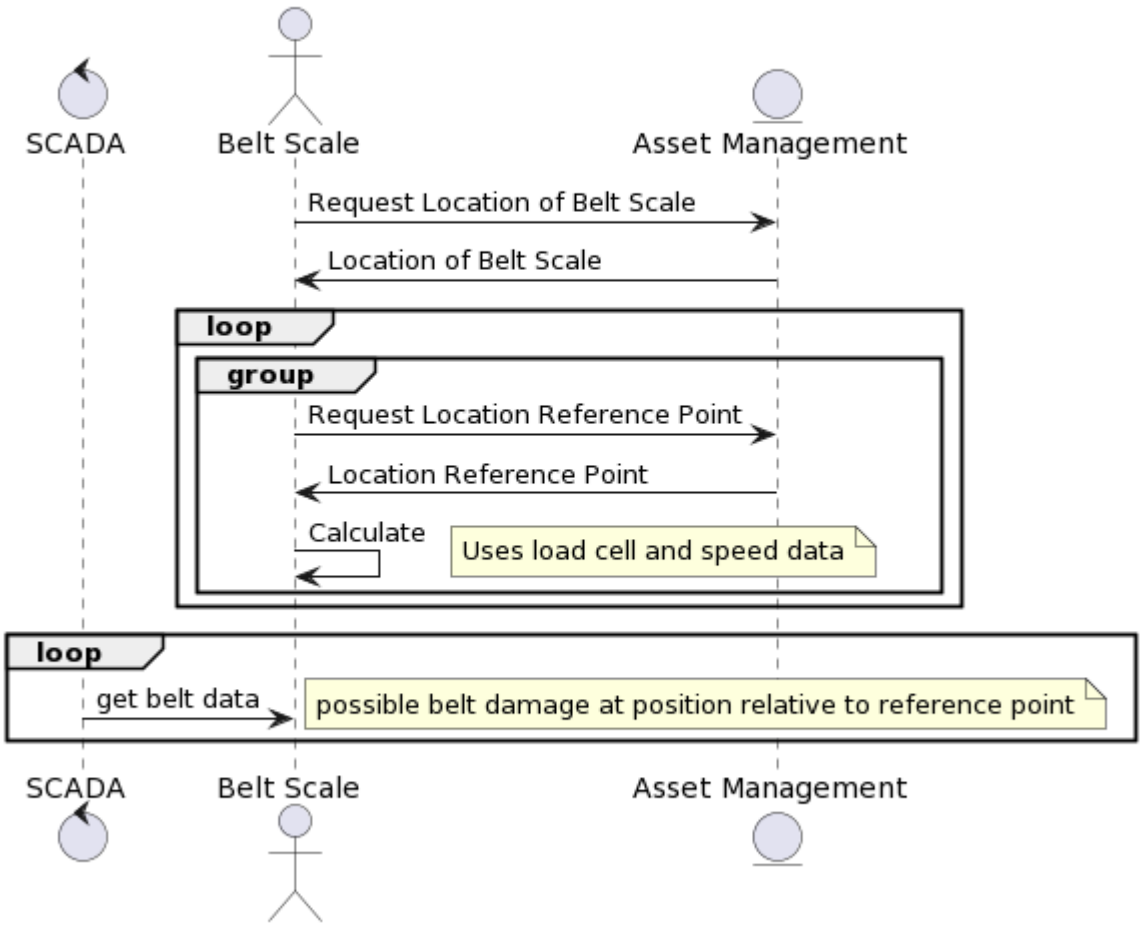
- Messwerte Wägezelle (kg) (Messwert Wägezelle)
- Bandgeschwindigkeit (m/s) (Belt speed)
-
- Belt Refernce point (-) Belt (Belt Reference Point)
- Schadensereignis (Ausgabewert, Bandwaage)(Belt Status (Schadensereignis)) bzw. errechnet Belt Damages (-) Belt (Belt Damages)
- Position der Bandwaage Assetmanagement (Belt scale location)

Description

Die Bandwaage errechnet aus diesen Größen mögliche Fehlerstellen im Band und signalisiert diese an nachgeschaltete Systeme wie z.B. Monitoring System oder Steuerung. Oder aus den Werten der Bandwaage ermittelt das übergeordnete System die Fehlerstellen. Hierzu sollte mind. ein Bandumlauf ausgewertet werden.

Abgestimmt: Sitzung **Prio 2**	**Datum:** 30.08.2022

Use Case # 17 "Bandfehler detektieren"



Use Case # 18 **(siehe 11)**	**Startvorgang einer längeren Förderstrecke**	Schulte Strathaus Herr Sudhoff

Background

Bei längeren Förderstrecken bestehend aus mehreren hintereinander geschalteten Gurtförderern werden die Anlagen in der Regel entgegen der Förderrichtung nacheinander gestartet. Die Materialaufgabe beginnt sobald die gesamte Förderstrecke aktiv ist. Dies führt dazu, dass die Reinigungssysteme über einen größeren Zeitraum an einer unbeladenen Anlage betrieben werden.

Lange Leerlaufzeiten bedeuten:

- Größerer Verschleiß der Abstreifersegmente
- Größerer Verschleiß des Fördergurts
- Höher Energieaufnahme des Gurtförderers

Solution

Das Reinigungssystem wird erst an den Fördergurt angestellt, wenn der Förderer beladen ist. Bei tiefen Temperaturen werden die Gurtabstreifer abgeklappt um das Festfrieren zu vermeiden

Benötigte Daten:

- Bandgeschwindigkeit (m/s) Bandwaage, SCADA, Motorsteuerung, Turbokupplung, Gurtförderer etc. (Belt speed)
- Beladung
  - Bandwaage (kg/m) oder
  - Beladungserkennung (0, 1) oder
  - Motorstrom (A) (Motor current)
- Position der Bandwaage/Beladungserkennung (Belt scale location) (m)) Assetmanagement
- Ambient temperatur (° C) Wetterstation

Description

Abgestimmt: Sitzung **Prio 1**	**Datum:** 30.08.2022

Ergänzt 23.01.2025

Use Case # 18 **(siehe 11)**	**Translation** **Startup process of a longer conveyor line.**	Schulte Strathaus Herr Sudhoff

Background

In the case of longer conveyor lines consisting of several belt conveyors connected in series, the systems are usually started one after the other in the opposite direction to the conveying direction. The material feed starts as soon as the entire conveyor line is active. This results in the cleaning systems being operated for a longer period of time on an unloaded line.

Long empty running times mean:

- Greater wear of the scraper segments
- Greater wear of the conveyor belt
- Higher energy consumption of the belt conveyor

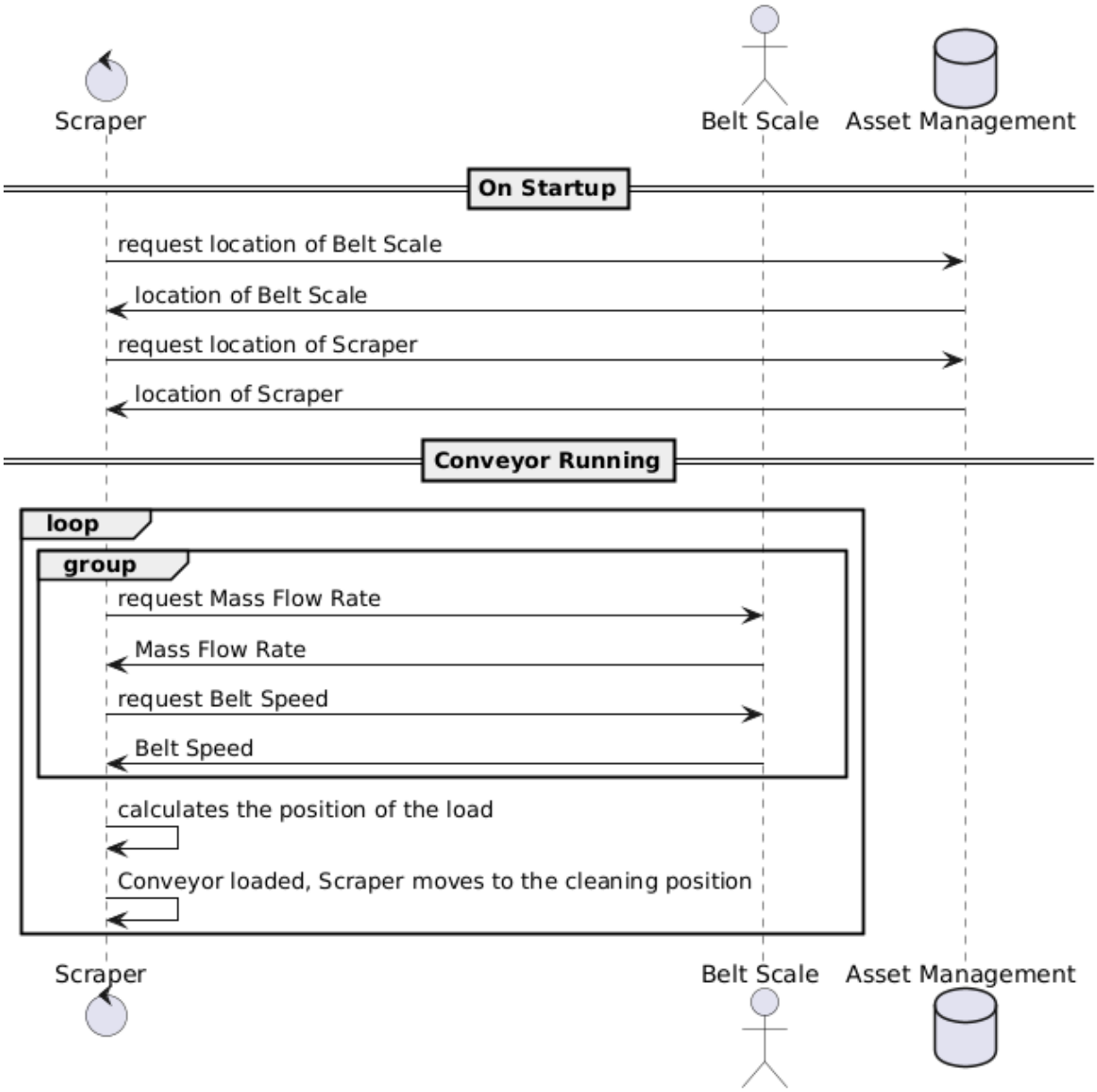
Solution

The cleaning system is not turned on to the conveyor belt until the conveyor is loaded.

Data required:

- Conveyor speed — Belt scale, belt conveyor, etc.
- Loading — belt scale, loading detection
- Position of the loading measurement

Description



Use Case # 19	**Reinigungssystem an Reversierbändern mit automatisch ab klappbaren Abstreifer**	Schulte Strathaus Herr Sudhoff

Background

Aufgrund der Bauart können Abstreifersegmente häufig nicht an reversierenden Bändern betrieben werden. Reversierbare Abstreifersysteme zeichnen sich häufig durch eine schlechtere Reinigungsleistung und eine höhere Störanfälligkeit aus. Hinzu kommt das an Reversierbändern an beiden Abwürfen Reinigungssysteme eingesetzt werden müssen. Bei tiefen Temperaturen werden die Gurtabstreifer abgeklappt um das Festfrieren zu vermeiden.

Sind zeitgleich die Reinigungssysteme an beiden Abwürfen aktiv führt das zu:

- Größerem Verschleiß der Abstreifersegmente
- Größerem Verschleiß des Fördergurts
- Höher Energieaufnahme des Gurtförderers

Solution

Das für die aktuelle Förderrichtung des reversierenden Gurtförderers wird aktiv geschaltet. Das Abstreifersystem an der Umkehrtrommel wird passiv geschaltet und vom Fördergurt abgefahren.

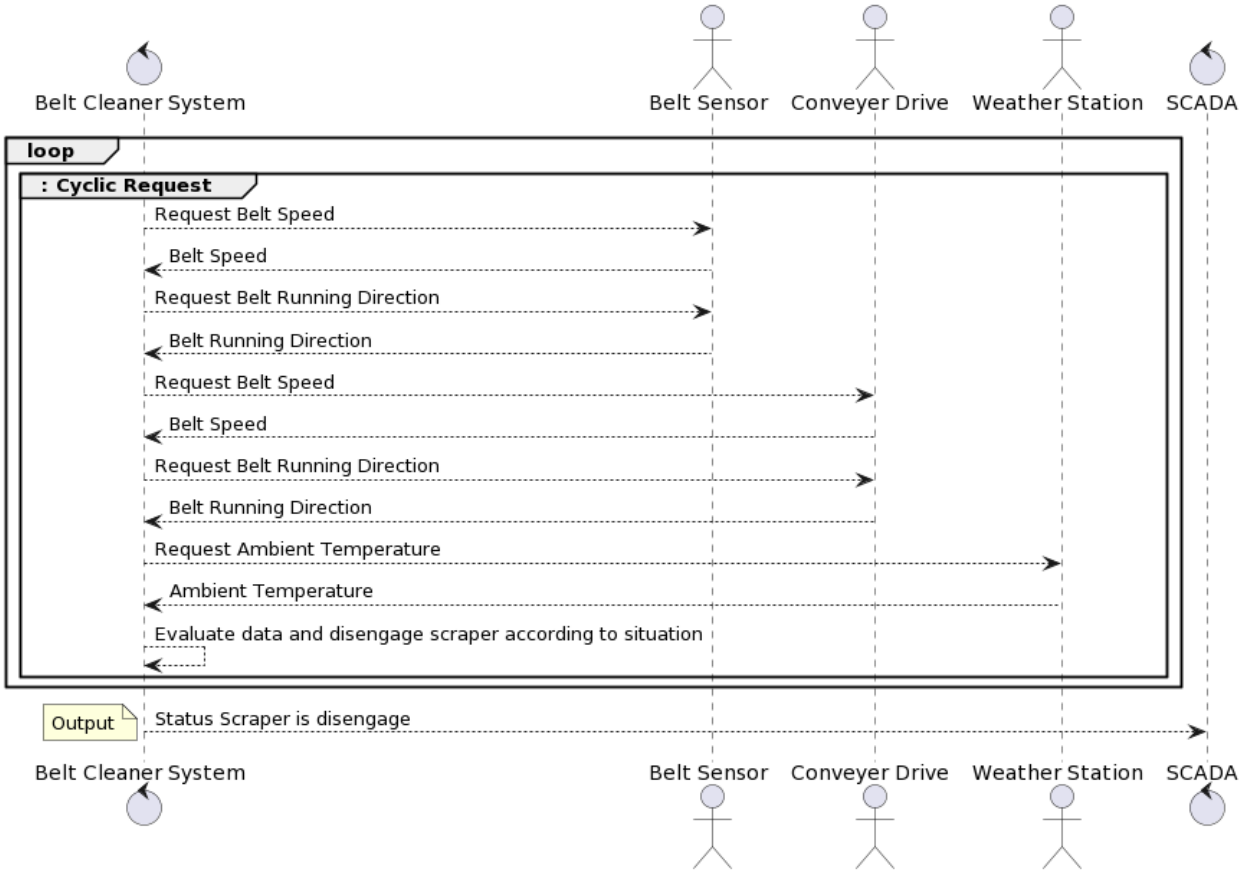
Benötigte Daten:

- Bandgeschwindigkeit (m/s) — Bandwaage, Gurtförderer (Belt sensor)
- Förderrichtung (1, 2) (Status) — Belt Sensor, Bandwaage, Gurtförderer (Parameter/Status missing)
- Ambient Temperature (° C) — Wetterstation (Temperature(s))

Description

Abgestimmt: Sitzung **Prio 1**	**Datum:** 30.08.2022

Use Case # 19 "Reinigungssystem an Reversierbändern mit automatisch abklappbaren Abstreifer"



Use Case #Nr 21	**Use Case Name age information**	Unternehmen RTT

Background

In the course of the years of operation of a conveyor belt, there are always repairs and replacement of belt sections, so that over time a conveyor belt can become very heterogeneous, it then consists of several belt sections and splices which differs both in age and in quality. The tape sections can be from different manufacturers and also differ in structure. Of course, the same applies to the splices, which can be made by different companies in different quality.
Same applies for pulleys: The lifetime of a pulley is different to the lifetime of a pulley lagging. The pulley lagging may be renewed several times during the lifetime of a pulley. But the knowledge of the data of renewal of the pulley lagging get lost very easy.

Solution

- One or more Tag Readers (*tagreader_id*)
- Belt section tag (*unique_id, manufacturer, model, production_site, production_date, installation_date, length, condition*)
- Belt splice tag (*unique_id, manufacturer* (Hersteller der Verbindung/Durchführender), *batch_number* (Verbindungspaket), *installation_date, length, condition*)
- Pulley lagging tag (*unique_id, manufacturer, model, production_site, production_date, installation_date, diameter, length, condition*)
- DigitalTwin / asset management database storing tag info

Electronically readable identification tags are embedded in the various flights of belt as well as in each splice and the pulley lagging of pulleys.

This tag information should be transmitted on request.

This gives you an up-to-date "as built" compilation of the conveyor belt. The corresponding production data for each ID is then (hopefully) stored in asset management database.

Any system that has the ability to read the ID's should provide them upon request.

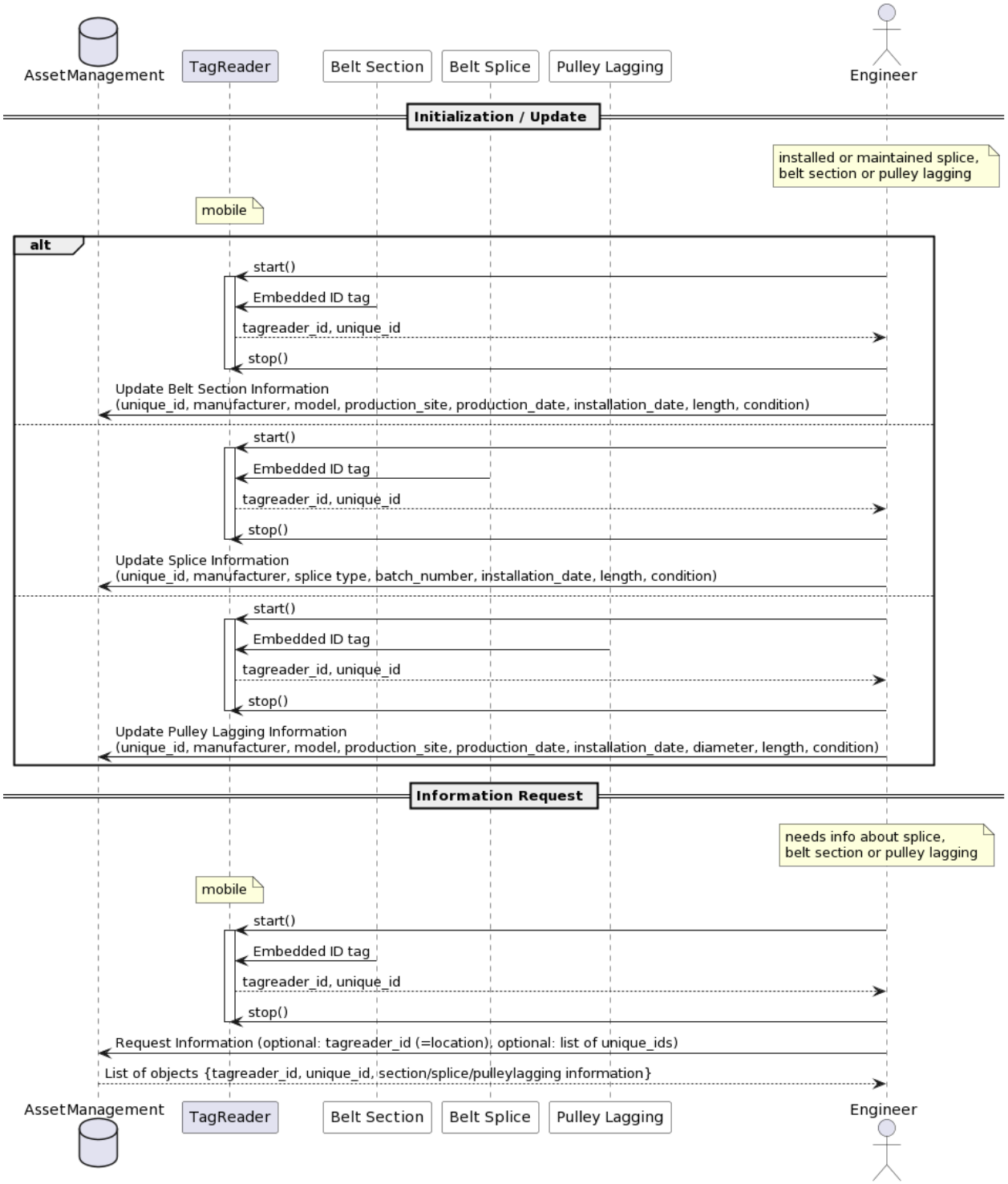
Description

1. Initialization during the first installation

Re-initalization during the maintenance of splices, belt sections and pulley lagging

Abgestimmt Datum: Prio 1	**Sitzung: 18.01.2024**

Use Case # 21 "Name Age information"



Status: 18.01.2024

Use Case #Nr 22	**Belt Monitoring System**	Unternehmen RTT

Background

Belt monitoring systems require information about the installed belts such as their actual belt length, belt speed, age or condition. In the event of damage, the affected belt section and the actual position should be known. The condition of the belt may subsequently be relevant for other components and applications, as they can react proactively to events such as known damage.

Solution

Für die Überwachung von Fördergurten können Systeme eingesetzt werden, wie z.B. in dem Fördergurt eingebettete Induktionsschleifen, RFID-Chip oder Magnete. Nach der Installation erkennt das Belt Monitoring System z.B. die Schleifen oder die optionalen RFID-Kennungen des Fördergurtes. Mit einer Diagnose überwacht das System ständig den Zustand des Gurtes und stellt Informationen bereit.

- Any system that identifies sections and/or belt splices or any other information (optional)
- Belt section (optional) (*unique_id, manufacturer, model, production_site, production_date, installation_date, length, condition*) (Liste n=0 – n)
- Belt splice (optional) (*unique_id, manufacturer* (Hersteller der Verbindung/Durchführender), *batch_number* (Verbindungspaket)*, installation_date, length, condition*) (Liste n=0 – n)
- Aktuelle Bandposition (optional) (inkl. Information zu belt/splice section)
- Splice condition (true (io), false (Abweichung vom Normalzustand) (dictionary)) (optional)
- Belt condition (true (io), false (Abweichung vom Normalzustand) (dictionary)) (optional)
- DigitalTwin / asset management database storing above info (optional)

This gives you an up-to-date "as built" compilation of the conveyor belt and the condition of the conveyor belt. The corresponding data is then stored in asset management database.

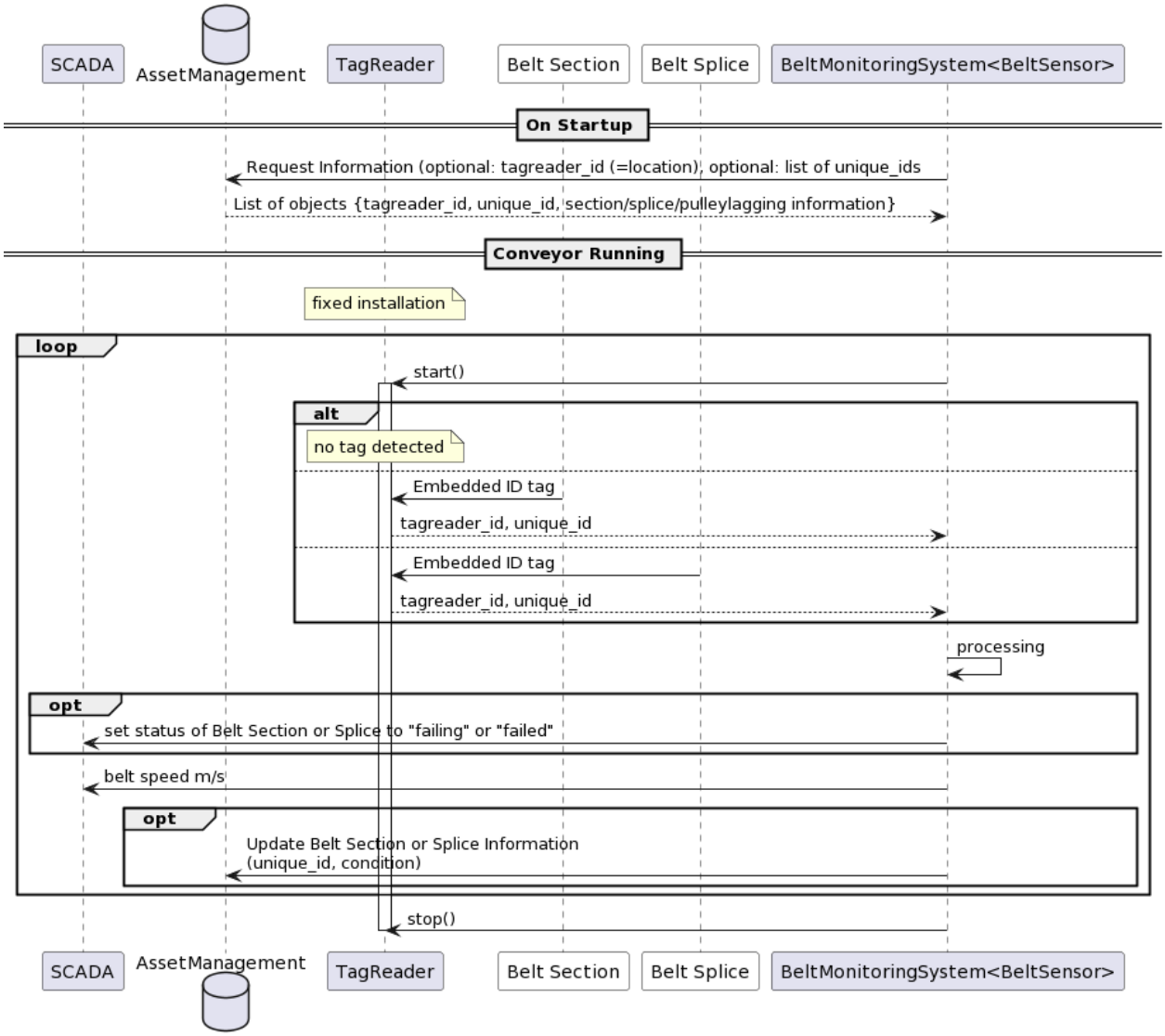
Description

When one or more Readers are installed at the conveyor, information such as actual belt length and actual belt speed can be derived.

The asset management database will be be updated or expanded when events are detected.

Abgestimmt Datum: 2024-07-23 Prio 1	**Sitzung Meeting**

Use Case # 22 "Belt Monitoring System"



01.02.2024

Use Case #Nr 23	**Use Case Name Betriebsparameter (KPI)**	Unternehmen: RTT / Siemens

Background

Die Einsatzzeit und Betrieb der einzelnen Komponenten des Gurtförderers ist eine wichtige Information für den Betreiber. Zusammen mit weiteren Informationen und den dynamischen Betriebsparameter können zusätzlich wichtige Aussagen zu Betriebsverhalten, Wartung und Standzeit gewonnen werden.

Solution

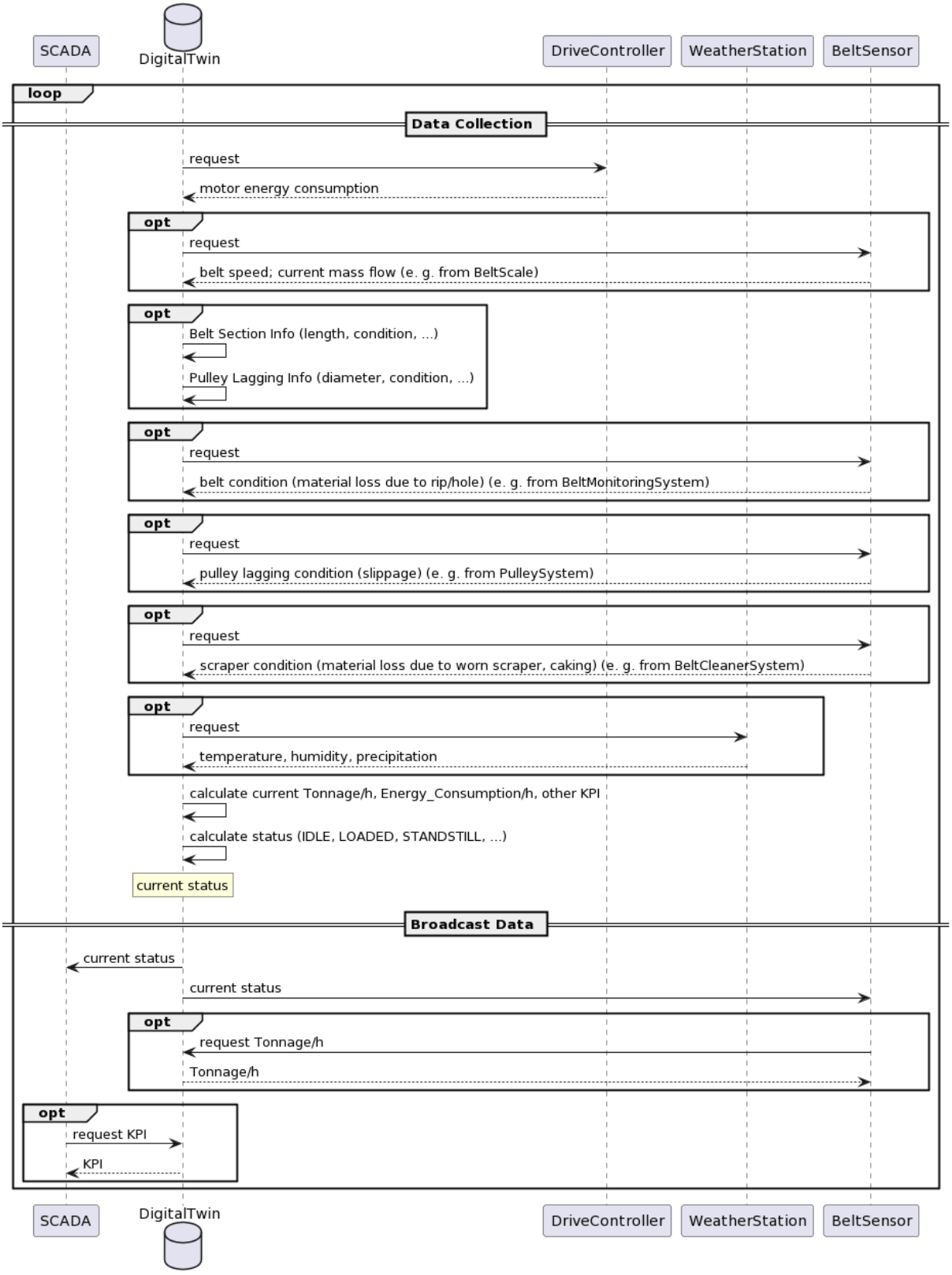
Der Digital Twin erhält folgende Signale:

- Stati:
  - o Leerlauf (*IDLE*)
  - o Beladen (*LOADED*)
  - o Stillstand (*STANDSTILL*)
- Geschwindigkeit von der Bandwaage oder einem Gurtüberwachungssystem (*Belt Sensor*)
- Gleitender Mittelwert von der Bandbelegung über Bandlänge von der Bandwaage (*belt load*)
- Energieaufnahme (kumuliert) *Motor energy consumption*)
- Zustandsdaten diverser Komponenten (Gurt, Abstreifer, Trommel, …)

Im Digital Twin/ kann man aus diesen Daten z.B. Lastkollektive für den Gurtförderer bzw. die einzelnen Komponenten des Gurtförderers ermitteln. Diese Zusatzinformationen gestatten es dem Betreiber, das Verhalten des Gurtförderers bzw. dessen Komponenten zu bewerten und ggf. Schlussfolgerungen für Instandhaltung und Ersatzteilmanagement zu ziehen.

Description

Abgestimmt Datum: Prio 2	**Sitzung**


SCADA
DigitalTwin
DriveController
WeatherStation
BeltSensor
loop
Data Collection
request
motor energy consumption
opt
request
belt speed; current mass flow (e. g. from BeltScale)
opt
Belt Section Info (length, condition, ...)
Pulley Lagging Info (diameter, condition, ...)
opt
request
belt condition (material loss due to rip/hole) (e. g. from BeltMonitoringSystem)
opt
request
pulley lagging condition (slippage) (e. g. from PulleySystem)
opt
request
scraper condition (material loss due to worn scraper, caking) (e. g. from BeltCleanerSystem)
opt
request
temperature, humidity, precipitation
calculate current Tonnage/h, Energy_Consumption/h, other KPI
calculate status (IDLE, LOADED, STANDSTILL, ...)
current status
Broadcast Data
current status
current status
opt
request Tonnage/h
Tonnage/h
opt
request KPI
KPI
SCADA
DigitalTwin
DriveController
WeatherStation
BeltSensor

Use Case #24	**Gurtüberwachung, Gurtschäden erkennen**	Schulte Strathaus Herr Sudhoff

Background

Fördergurte unterliegen im laufenden Betrieb Verschleiß und können Schaden nehmen. Gurtschäden werden häufig nicht immer sofort erkannt. Defekte Verbindungen, defekte Reparaturflicken, gerissene Stahlseile, sich lösende Deckschichten können schnell zu gravierenden Schäden und langen ungeplanten Stillstandzeiten des Gurtförderers führen. Da sich diese Gurtschäden meistens über einen gewissen Zeitraum anbahnen, sollten diese frühzeitig erkannt und gemeldet und repariert werden. Rechtzeitig durchgeführte Wartungen können die Kosten einer Reparatur stark senken.

Solution

Zur Detektion von Gurtschäden kann ein Abstreifer eingesetzt werden, der den Fördergurt während des Gurtlaufes kontinuierlich abtastet. Der Abstreifer bietet sich an, da er sowieso immer am Fördergurt anliegt und in unmittelbarer Nähe der Übergabe des Gurtförderers sitzt. An diesen Stellen ist der Fördergurt nicht gemuldet und der Abstreifer kann die ganze Gurtbreite abtasten.

Description

Der Abstreifer wird mit Sensoren zum Abtasten bzw. zum Detektieren von Gurtschäden ausgerüstet. Zusätzlich wird für die Erfassung der Gurtgeschwindigkeit und zur Bestimmung der Gurtposition eine Messrolle an dem Gurtförderer installiert. Über ein Scraper Itelligence Modul (SIM) erfolgt die Auswertung der Sensoren und der Messrolle und Gurtschäden werden gemeldet. Nach einer Referenzfahrt, mit mindestens einem Gurtumlauf, werden aus den ermittelten Daten, über verschiedene Berechnungen, Grenzwerte (Level 1,2,3) ermittelt. Bei laufendem Gurtförderer werden beim Überschreiten der Grenzwerte, diese als Gurtschäden erkannt und Aktionen ausgelöst.

Die folgenden Informationen können von der SIM an andere Steuerungen, Systeme weitergegeben werden:

- Ausgabe Gurtschaden Level 1, Level 2, Level 3 (0/1)
- Angabe der Schadensposition (m)
- Zeitstempel des Gurtschadens
- Aktuelle Gurtnullposition (m)
- Gurtlänge (m)
- Bandgeschwindigkeit (m/s)
- Betriebsart (Normalbetrieb, Referenzfahrt)

Abgestimmt: Prio ?	**Datum:**

Use Case #24 Ergänzt 23.01.2025	**Translation**	Schulte Strathaus Herr Sudhoff

Background

Conveyor belts are subject to wear during operation and can become damaged. A belt damage is often not always recognized immediately. Defective splices, defective repair patches, torn steel cords and detached cover layers can quickly lead to serious damage and long unplanned downtimes of the belt conveyor. As this belt damage usually develops over a certain period, it should be detected, reported and repaired at an early stage. Timely maintenance can greatly reduce the cost of repairs.

Solution

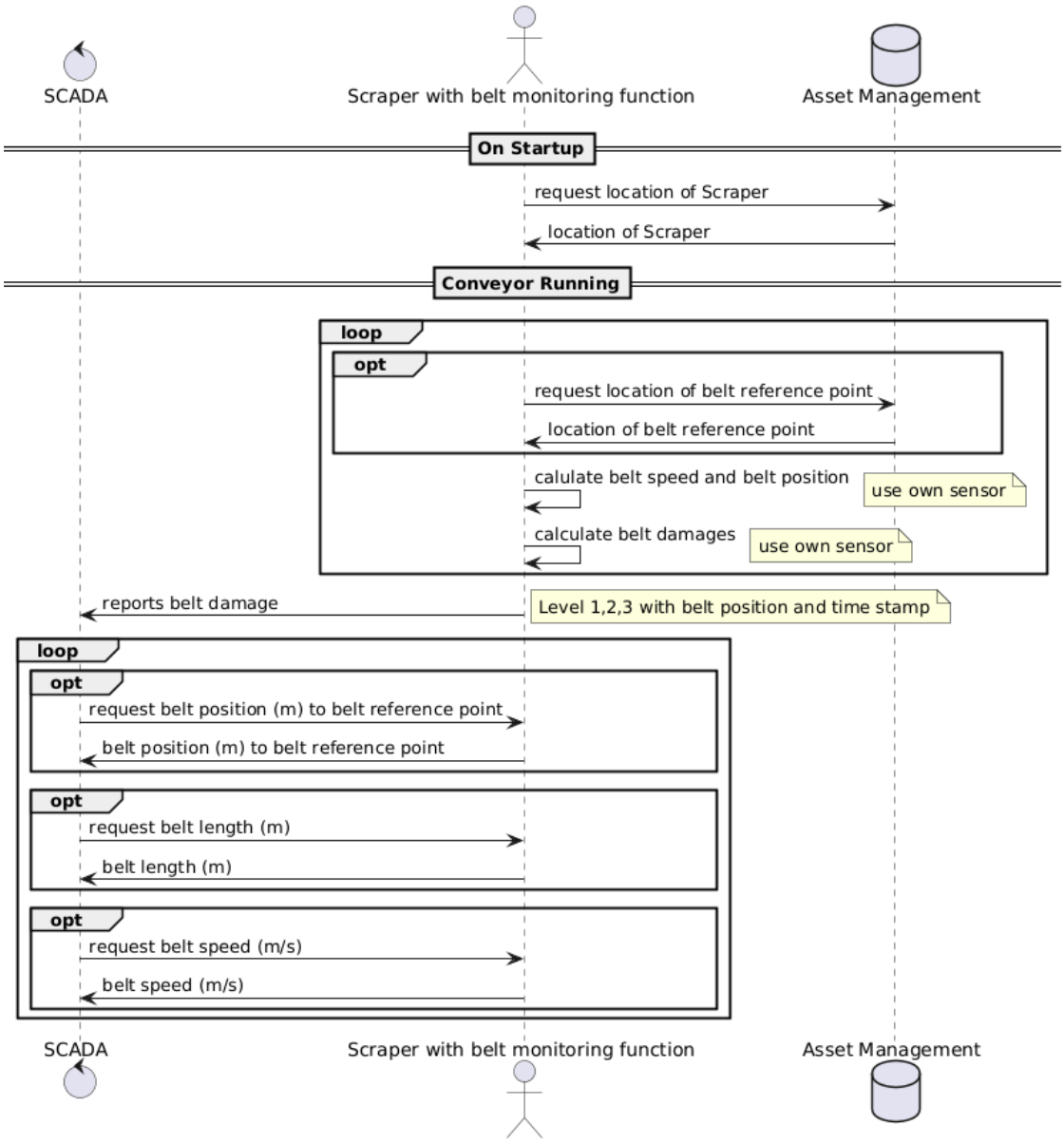
To detect belt damage, a scraper can be used to continuously scan the conveyor belt while it is running. The scraper is ideal as it is always in contact with the conveyor belt anyway and is in the immediate vicinity of the transfer point of the belt conveyor. The conveyor belt is not troughed at these points and the scraper can scan the entire belt width.

Description

The scraper is equipped with sensors for scanning and detecting belt damage. In addition, a measuring roller is installed at the belt conveyor to record the belt speed and determine the belt position. A scraper intelligence module (SIM) evaluates the sensors and the measuring roller and reports any belt damage. After a reference run with at least one belt circulation, limit values (level 1, 2, 3) are determined from the data obtained using various calculations. When the belt conveyor is running and the limit values are exceeded, this is recognized as belt damage and actions are triggered.

The following information can be passed on from the SIM to other control units and systems:

- Output belt damage level 1, level 2, level 3 (0/1)
- Indication of the damage position (m)
- Time stamp of the belt damage
- Current belt zero position (m)
- Belt length (m)
- Belt Speed (m/s)
- Operating mode (normal operation, reference run)


SCADA
Scraper with belt monitoring function
Asset Management
On Startup
request location of Scraper
location of Scraper
Conveyor Running
loop
opt
request location of belt reference point
location of belt reference point
calulate belt speed and belt position
use own sensor
calculate belt damages
use own sensor
reports belt damage
Level 1,2,3 with belt position and time stamp
loop
opt
request belt position (m) to belt reference point
belt position (m) to belt reference point
opt
request belt length (m)
belt length (m)
opt
request belt speed (m/s)
belt speed (m/s)
SCADA
Scraper with belt monitoring function
Asset Management

Use Case #25	**Gurtüberwachungssystem**	Pfreundt GmbH Schulte Strathaus

Background

Fördergurte unterliegen im laufenden Betrieb Verschleiß und können Schaden nehmen. Gurtschäden werden häufig nicht immer sofort erkannt. Defekte Verbindungen, defekte Reparaturflicken, gerissene Stahlseile, sich lösende Deckschichten können schnell zu gravierenden Schäden und langen ungeplanten Stillstandzeiten des Gurtförderers führen. Da sich diese Gurtschäden meistens über einen gewissen Zeitraum anbahnen, sollten diese frühzeitig erkannt und gemeldet und repariert werden. Rechtzeitig durchgeführte Wartungen können die Kosten einer Reparatur stark senken.

Solution

Zur Detektion von Gurtschäden kann ein Gurtüberwachungssystem eingesetzt werden, das den Fördergurt während des Gurtlaufes kontinuierlich abtastet.

Description

Das Gurtüberwachungssystem ist mit Sensoren zum Abtasten bzw. zum Detektieren von Gurtschäden ausgerüstet. Zusätzlich ist für die Erfassung der Gurtgeschwindigkeit und zur Bestimmung der Gurtposition eine Messrolle an dem Gurtförderer installiert. Über das Gurtüberwachungssystem erfolgt die Auswertung der Sensoren und der Messrolle und Gurtschäden werden gemeldet.

Nach einer Referenzfahrt, mit mindestens einem Gurtumlauf, werden aus den ermittelten Daten, über verschiedene Berechnungen, Grenzwerte ermittelt. Bei laufendem Gurtförderer werden beim Überschreiten der Grenzwerte, diese als Gurtschäden erkannt und Aktionen ausgelöst.

Die folgenden Informationen können von dem Gurtüberwachungssystem an andere Steuerungen, Systeme weitergegeben werden:

- Ausgabe des Gurtschaden Levels (Warnung, Fehler, schwerwiegender Fehler)
- Angabe der Gurtschadensposition (m)
- Zeitstempel des Gurtschadens
- Gurtschadenart, optional (lösende Decksschicht, defekte Verbindung, defekter Reparaturflicken, gerissene Stahlseile)
- Aktuelle Gurtnullposition (m)
- Gurtlänge (m)
- Bandgeschwindigkeit (m/s)
- Betriebsart (Normalbetrieb, Referenzfahrt)

Abgestimmt:	**Datum:**

Use Case #25	**Belt Monitoring System**	Pfreundt GmbH Schulte Strathaus

Background

Conveyor belts are subject to wear during operation and can become damaged. A belt damage is often not always recognized immediately. Defective splices, defective repair patches, torn steel cords and detached cover layers can quickly lead to serious damage and long unplanned downtimes of the belt conveyor. As this belt damage usually develops over a certain period, it should be detected, reported and repaired at an early stage. Timely maintenance can greatly reduce the cost of repairs.

Solution

To detect belt damage, a belt monitoring system can be used to continuously scan the conveyor belt while it is running.

Description

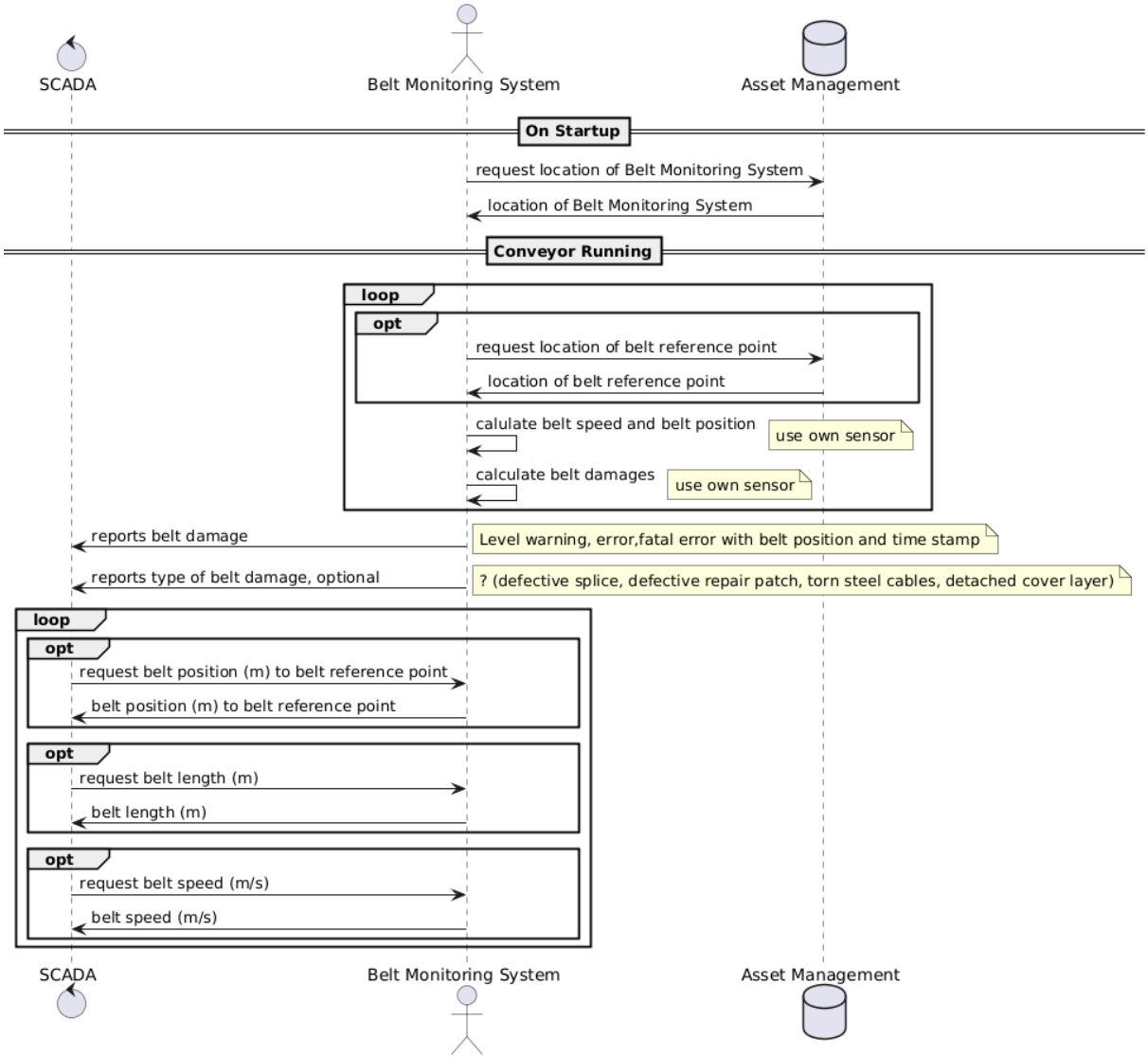
The belt monitoring system is equipped with sensors for scanning and detecting belt damage. In addition, a measuring roller is installed at the belt conveyor to record the belt speed and determine the belt position. The belt monitoring system evaluates the sensors and the measuring roller and reports any belt damage.

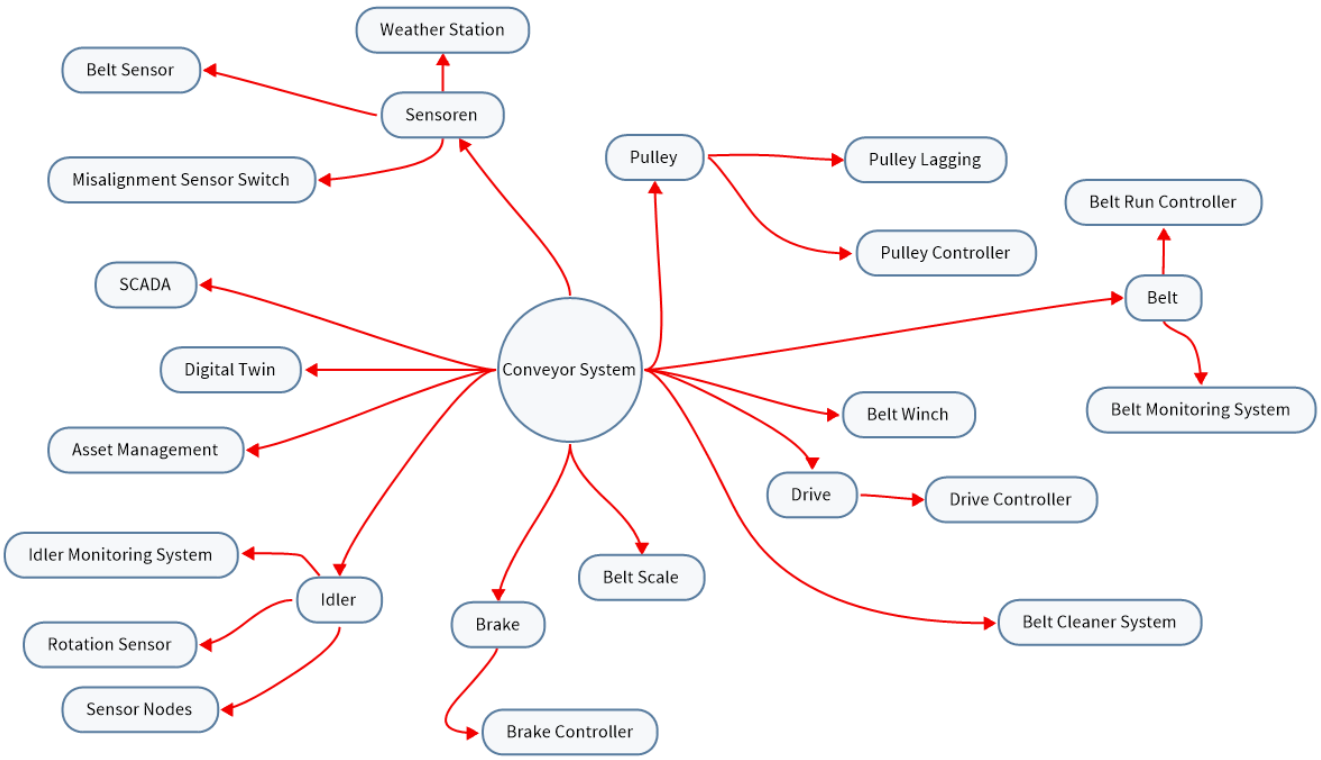
After a reference run with at least one belt circulation, limit values (levels for waring, error, fatal error) are determined from the data obtained using various calculations. When the belt conveyor is running and the limit values are exceeded, this is recognized as belt damage and actions are triggered.

The following information can be passed on from the belt monitoring system to other control units and systems:

- Output Belt damage level (warning, error, fatal error)
- Indication of the damage position (m)
- Time stamp of the belt damage
- Type of belt damage, optional (defective splice, defective repair patch, torn steel cables, detached cover layer)
- Current belt zero position (m)
- Belt length (m)
- Belt Speed (m/s)
- Operating mode (normal operation, reference run)

Abgestimmt:


SCADA
Belt Monitoring System
Asset Management
On Startup
request location of Belt Monitoring System
location of Belt Monitoring System
Conveyor Running
loop
opt
request location of belt reference point
location of belt reference point
calulate belt speed and belt position
use own sensor
calculate belt damages
use own sensor
reports belt damage
Level warning, error,fatal error with belt position and time stamp
reports type of belt damage, optional
? (defective splice, defective repair patch, torn steel cables, detached cover layer)
loop
opt
request belt position (m) to belt reference point
belt position (m) to belt reference point
opt
request belt length (m)
belt length (m)
opt
request belt speed (m/s)
belt speed (m/s)
SCADA
Belt Monitoring System
Asset Management


Weather Station
Belt Sensor
Sensoren
Misalignment Sensor Switch
Pulley
Pulley Lagging
Pulley Controller
Belt Run Controller
SCADA
Belt
Digital Twin
Conveyor System
Belt Monitoring System
Belt Winch
Asset Management
Drive
Drive Controller
Idler Monitoring System
Belt Scale
Idler
Brake
Belt Cleaner System
Rotation Sensor
Sensor Nodes
Brake Controller