WERCSTAT
ERP software developers

Framework Overview

wercstat.com

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This document is part of the `wercstat` low-code framework (https://www.wercstat.com).

The following documents are available:

(1) `Wercstat Overview`: introduction to the framework

(2) `Wercstat Getting Started`: installation instructions and hello-world tutorial

(3) `Wercstat Value Types`: description of `Java` domain value types

(4) `Wercstat Server DSL`: description of the server-side Domain Specific Language

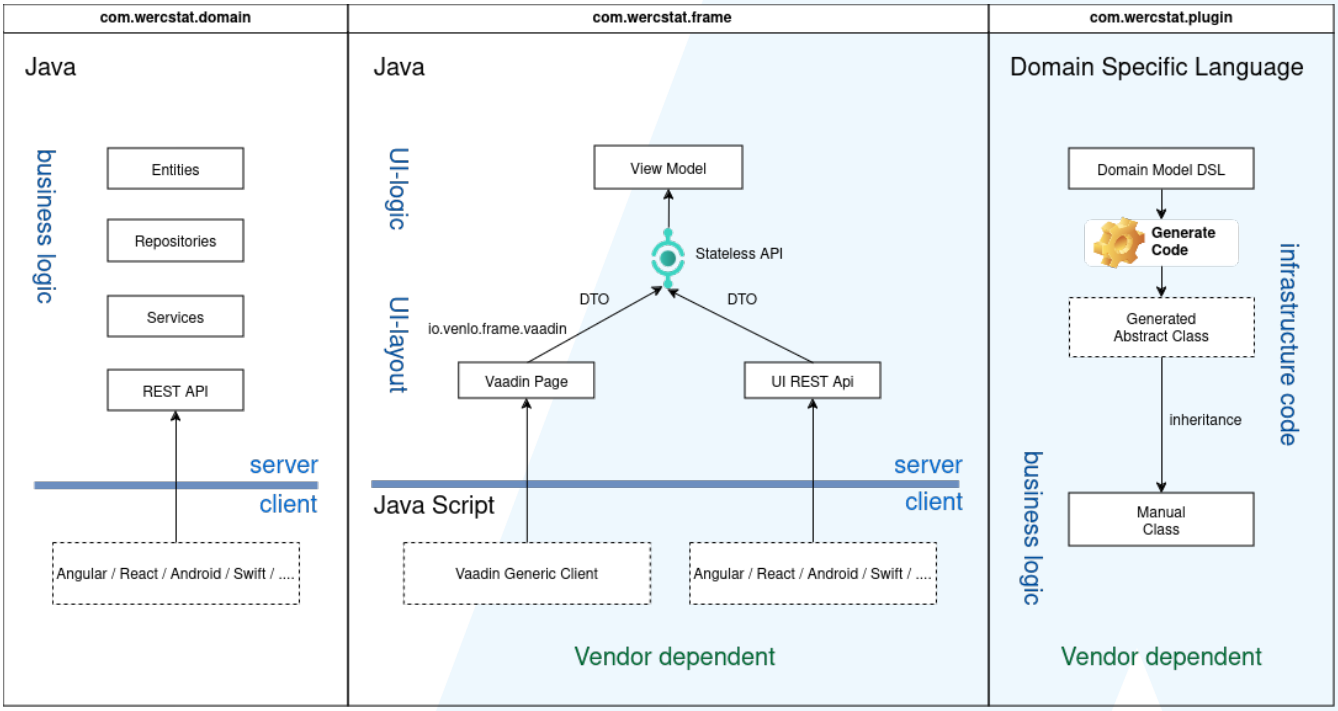
(5) `Wercstat Client DSL`: description of the client-side Domain Specific Language

Overview

Components

`Wercstat` consists of three distinct parts:

- `com.wercstat.domain` : the library containing value-types and entity base classes.
- `com.wercstat.frame` : the library containing UI components and client-server communication.
- `com.wercstat.plugin`: the `Eclipse` plugin provides the domain-model editor and code-generator.

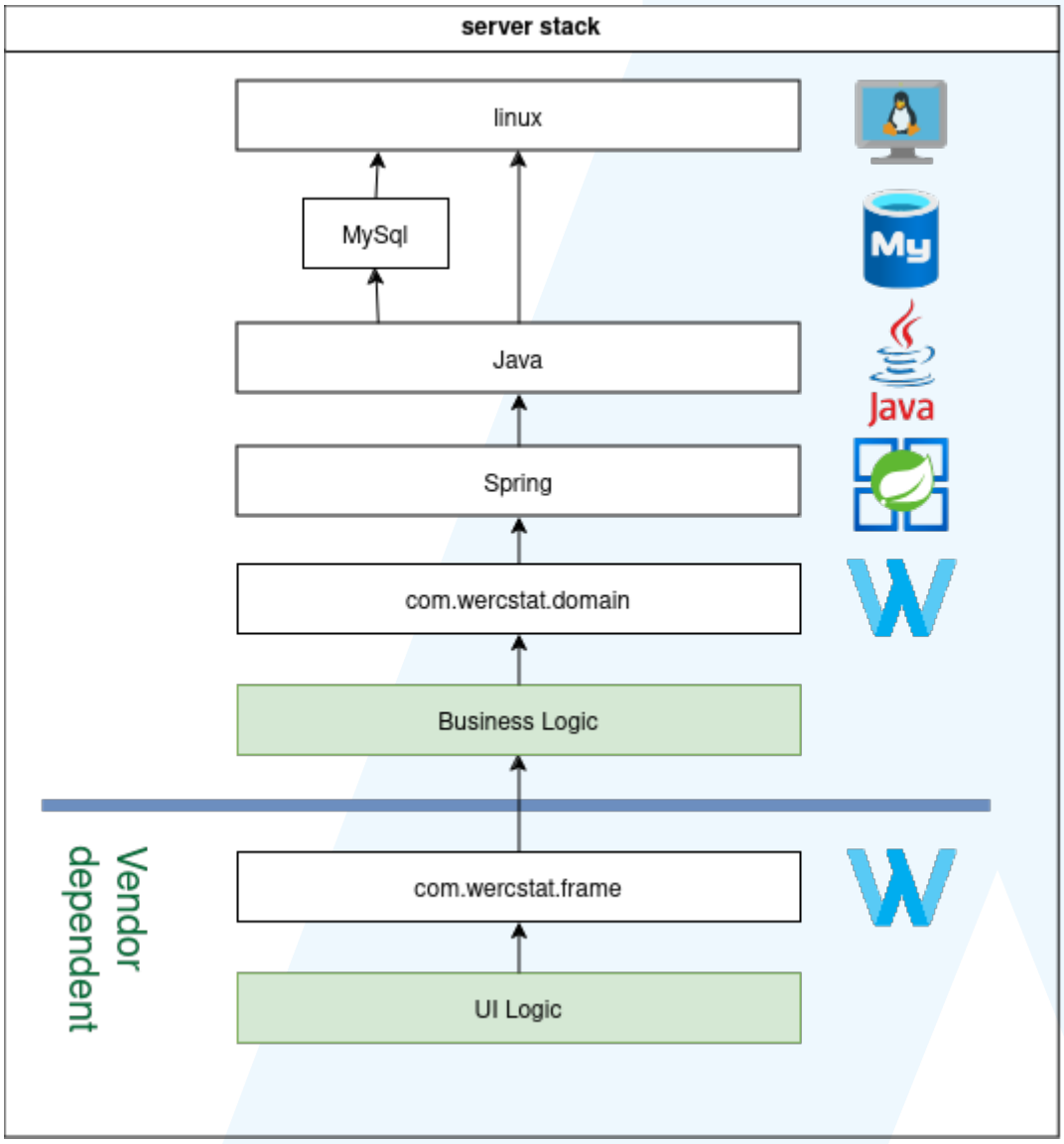


Notes:

- Business code depends on `com.wercstat.domain` as it provides support for entities and value-types. To prevent vendor lock-in this library is provided as open-source with a permissive license.
- `com.wercstat.frame` servers are stateless. The only server-side state is maintained by `Vaadin` Pages. This makes the application scalable and a good fit for client-side UIs that communicate via `REST`.
- `com.wercstat.plugin` generated code is split into abstract classes with all the logic, and empty concrete sub-classes. Both are by default stored in the `src/generated` code folder. By adding the `custom` keyword to the `DSL` component, the empty concrete class is moved from the `src/generated` folder to `src/main/java`, where the developer can add business logic. This ensures there is a clean separation between manual code and generated code.

Server Stack

Most of the server stack consists of open-source software, including the `wercstat.io.domain` library for value-type and entity support. User interaction logic depends on the `wercstat.io.frame` libraries, which are vendor dependent.



Technologies

Wercstat is compatible with all major databases, operating systems and cloud providers.

Entity to Page

A typical core-business application consists of hundreds of persistent entities (i.e. database tables). This example illustrates the code required for a new `Terms of Delivery` entity, from persistence to a web maintenance page (Create, Update, Delete).

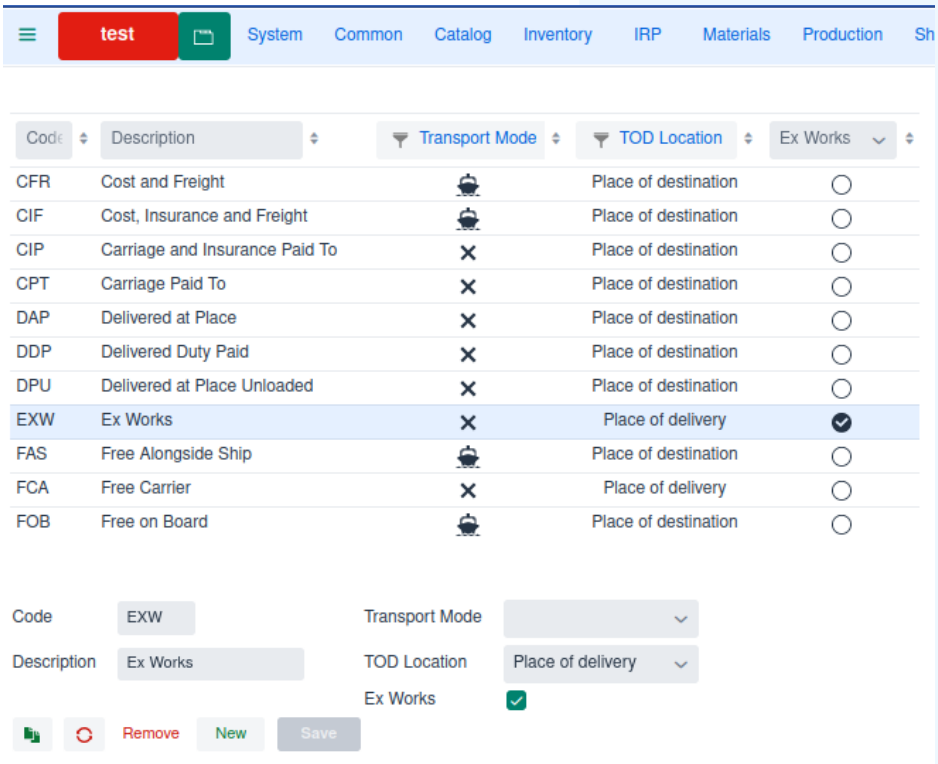


Figure 1. Terms-of-delivery web-page end result

Server side

First step is to create a `TermsOfDelivery.real` source file for the labels, entity and `view-model` declaration. `DSL` files have a `.real` extensions, which allows `Eclipse` to recognize the language and provide keyword coloring and auto-completion.

Add `labels`

Labels are declared with the `label-set` keyword, and can be translated using standard `Java` internationalization (`i18n`) functionality.

Create labels for the required fields, and enumerate values:

```
label-set TermsOfDeliveryLabels{
    label codeLabel "Code"
    label descriptionLabel "Description" ①
    label exWorksLabel "Ex Works"

    label transportModeLabel "Transport Mode"
    label transportModeLabelA "Air" icon ICON_AIR ②
    label transportModeLabelI "Rail" icon ICON_RAIL
    label transportModeLabelR "Road" icon ICON_ROAD
    label transportModeLabelS "Sea" icon ICON_SEA

    label termsOfDeliveryLocationLabel "TOD Location"
    label termsOfDeliveryLocationLabelPLDY "Place of delivery" ②
    label termsOfDeliveryLocationLabelPLDN "Place of destination"
    label termsOfDeliveryLocationLabelPOST "Port of shipment"
    label termsOfDeliveryLocationLabelPODN "Port of destination"
}
```

① field labels

② enumerate labels

Add `value types`

For programming business logic `Wercstat` does not use primitive type (`string`, `boolean`, `decimal`, etc.) but domain specific value-types.

Create the value-types, using the previously declared labels:

```
string TermsOfDeliveryCode codeLabel 3
string Description descriptionLabel 30
boolean ExWorks exWorksLabel

enumerate TransportMode transportModeLabel
{
    A: transportModeLabelA ①
    I: transportModeLabelI
    R: transportModeLabelR
    S: transportModeLabelS
}

enumerate TermsOfDeliveryLocation termsOfDeliveryLocationLabel
{
    PLDY: termsOfDeliveryLocationLabelPLDY ②
    PLDN: termsOfDeliveryLocationLabelPLDN
    POST: termsOfDeliveryLocationLabelPOST
    PODN: termsOfDeliveryLocationLabelPODN
}
```

① `"A"` is the code in the database, and `transportModeLabelA` (`"Air"`) the label displayed in the form and grid.

② `"PLDY"` is the code in the database, and `termsOfDeliveryLocationLabelPLDY` (`"Place of delivery"`) the label displayed in the form and grid.

Add `entity`

In this example the entity represents the table in the database, and defines all the attributes that constitute a `terms-of-delivery`.

Create the entity definition, using the previously declared value-types:

```
entity master TermsOfDelivery termsOfDeliveryLabel
{
    business-key code ①
    search-paths description ②

    user-fields { ③
        attribute TermsOfDeliveryCode code
        attribute Description description
        attribute TransportMode transportMode optional
        attribute TermsOfDeliveryLocation termsOfDeliveryLocation
        attribute ExWorks exWorks default false
    }
}
```

① `terms-of-delivery` codes are unique

② when the user enters a search-term to select a record, both the `code` and `description` are searched

③ all fields are maintained by the user

The database table corresponding with the entity can be created automatically, using the standard `Java` persistence `API` (`JPA`).

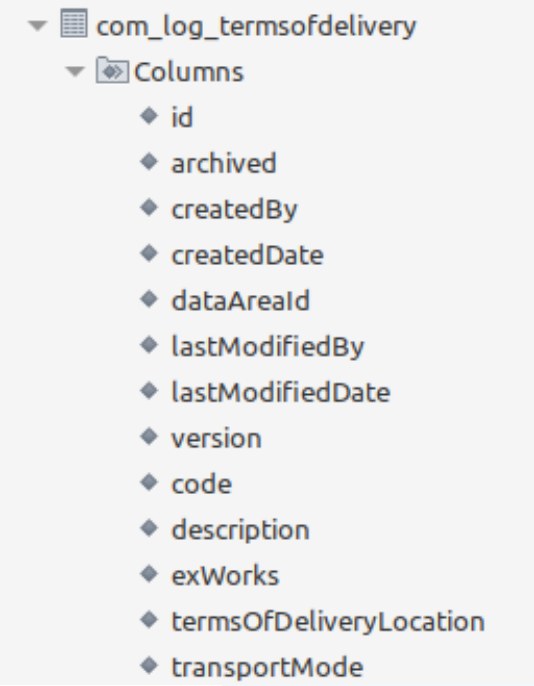


Figure 2. MySQL database table, created by JPA

System fields are automatically added to register creation date-time, modify date-time, version and data-area (for multi-tenancy).

Add `view-model`

The `view-model` defines all the fields and actions that are available in the user-interface. For `terms-of-delivery` it consists only of entity-fields, no extra form-fields or actions are required.

Create the `view-model`, using the previously declared entity:

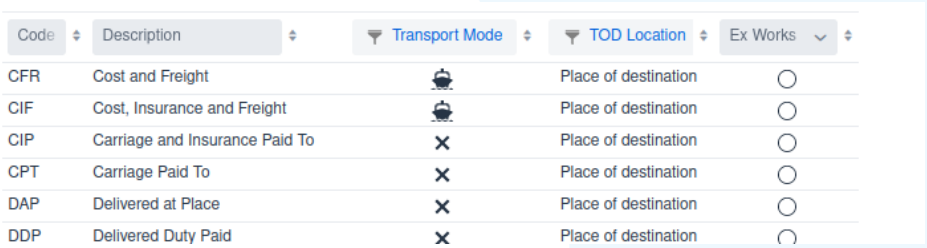
```
package com.wercstat.erp.client.com.log

viewmodel TermsOfDeliveryViewModel{
    entity TermsOfDelivery
}
```

Client side project

For a clean server / client separation, create a new `TermsOfDeliveryPage.real DSL` file for the form, grid and page.

Add `grid`

The grid displays a list of `terms-of-delivery` records on the web-page. It has search and sorting functionality by default.



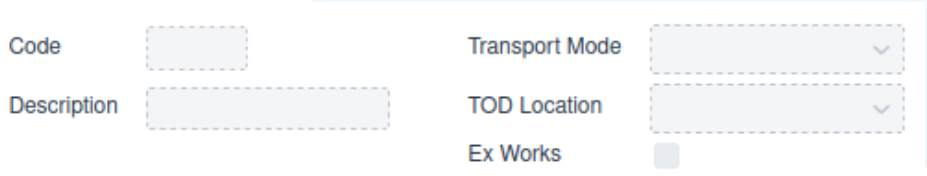
Code	Description	Transport Mode	TOD Location	Ex Works
CFR	Cost and Freight		Place of destination	
CIF	Cost, Insurance and Freight		Place of destination	
CIP	Carriage and Insurance Paid To		Place of destination	
CPT	Carriage Paid To		Place of destination	
DAP	Delivered at Place		Place of destination	
DDP	Delivered Duty Paid		Place of destination	

Create the grid, using the previously declared `view-model`*:*

```
grid TermsOfDeliveryGrid
{
    viewmodel TermsOfDeliveryViewModel

    field code
    field description
    field transportMode
    field termsOfDeliveryLocation
    field exWorks
}
```

Add `form`

The form provides fields for modifying `terms-of-delivery` attributes.



Create the form, using the previously declared `view-model`*:*

```
form TermsOfDeliveryForm
{
    viewmodel TermsOfDeliveryViewModel

    field code
    field description

    next-column

    field transportMode
    field termsOfDeliveryLocation
    field exWorks
}
```

Add `page`

The page combines grids and forms, and links them together with one or more `view-models`.

Create the page, using the previously declared `view-model`, grid and form:

```
page TermsOfDeliveryPage termsOfDeliveryLabel{

    viewmodel TermsOfDeliveryViewModel todViewModel ①

    view TermsOfDeliveryGrid termsOfDeliveryGrid todViewModel ②
    view TermsOfDeliveryForm termsOfDeliveryForm todViewModel defaultToolbar ③

    segment pane1 termsOfDeliveryLabel ④
    {
        display termsOfDeliveryGrid
        input termsOfDeliveryForm
    }
}
```

① declare `view-model`

② link `view-model` to the grid

③ link `view-model` to the form and add a default toolbar with `Remove`, `New` and `Save` buttons.

④ declare the layout of grid and form

Add `menu`

The `menu DSL` keyword provides a convenient way to group pages into hierarchical menu's that can be displayed anywhere in the user interface.

Find the menu for the module (in this case `com.log`), and add the page to the menu.

Create the menu-entre, using the previously declared page:

```
menu Menu_com_log com_log_Label ①
{
    page NumberSeriesPage
    page TermsOfDeliverPage ②
}
```

① the menu is called `com_log` according to the module structure.

② new `terms-of-delivery` page

Authorization

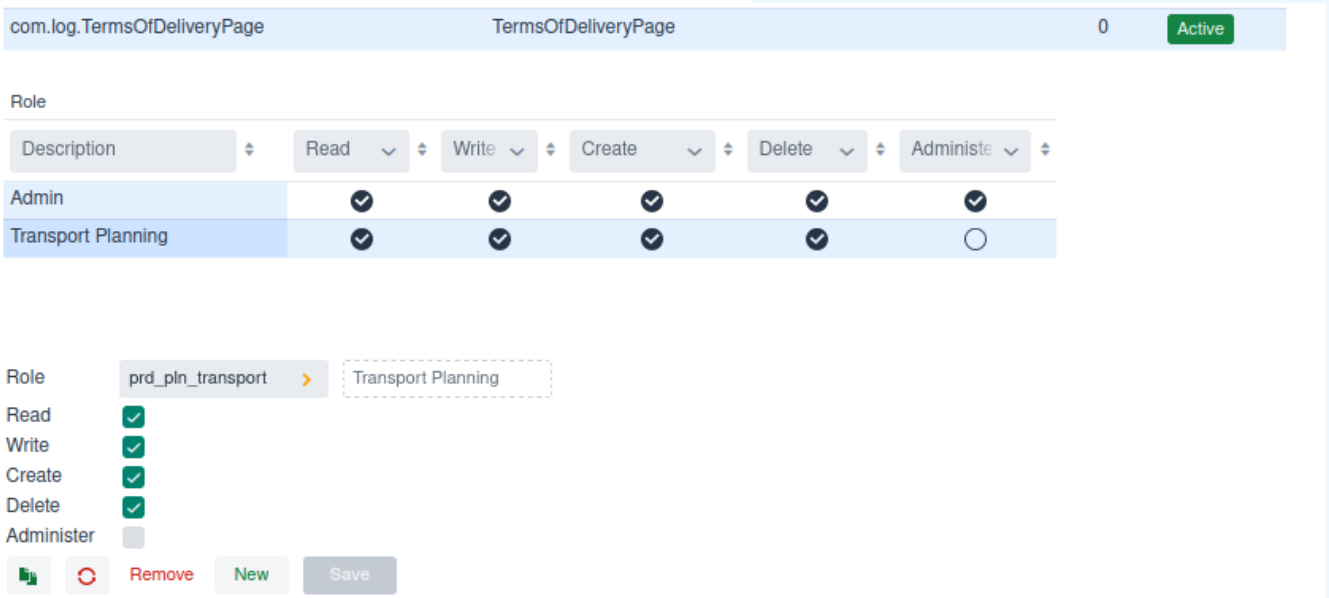
Now the `terms-of-delivery` page is created and added to the menu, the application can be started to add authorizations and display the page.

Add page to Access Control List (ACL)

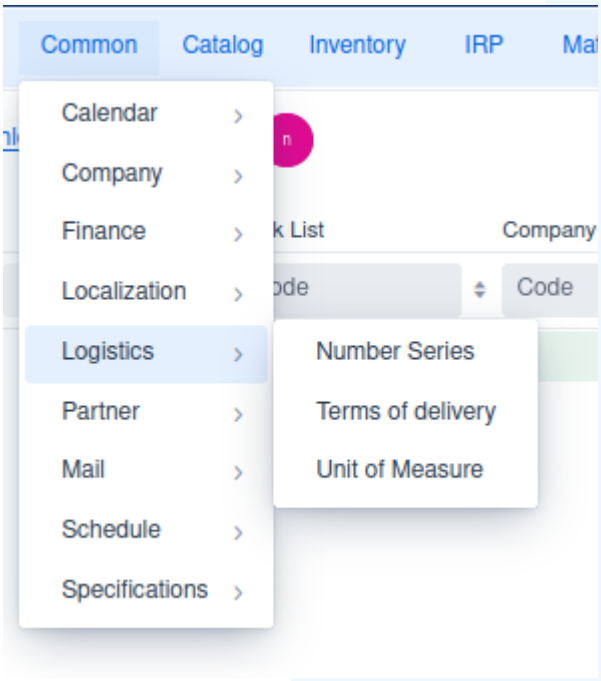
User can only access pages for which they are authorized. Open the `ACL Type` page and select object type `Page`. Press the `import objects` to add all `Java Page` files to the ACL object list. A message will confirm that a new `ACL Object` was added.

Add ACL Authorization

Open the `ACL Role` menu option and select the `Page` object types, and the `TermsOfDelivery` entry. Add new `roles` with maintenance rights.



Refresh the web-page to see the added authorizations in the menus.



Select the new page

The end-result is a fully functional page where terms-of-delivery can be added, modified and deleted.

At any time custom logic can be added using `Java`, simply by adding the `custom` keyword to `entity`, `view-model`, `form`, `grid` or `page`.

Generated Code

Every DSL component generates one or more source files. These generated files are located in a separate source folder and not directly relevant for the developer. None the less, it is good to have a general understanding of all the code, including generated classes.

The generated source code is clean, structured and easy to understand. In principle all these classes could also be written by hand. However, the DSL code-generator makes it far more convenient and less error-prone

The DSL essentially reduces the source-code of the system as a whole. Generated files are derived and not part of the source code and do not requiring maintenance.

This section goes through all the components mentioned in the Entity to Page section, and provides an illustration of the generated code.

Server side project

Add labels

The label-set generates two code files:

(1) a Java class with label constants.

These are used in code to reference labels. Using constants in stead of string-values, ensures that name-changes result in compilation errors.

Generated Code

```
public class TermsOfDeliveryLabels{

    public static final String CODE_LABEL = "codeLabel";
    public static final String DESCRIPTION_LABEL = "descriptionLabel";
    public static final String EX_WORKS_LABEL = "exWorksLabel";
    public static final String TRANSPORT_MODE_LABEL = "transportModeLabel";
    public static final String TRANSPORT_MODE_LABEL_A = "transportModeLabelA";
    public static final String TRANSPORT_MODE_LABEL_I = "transportModeLabelI";
    public static final String TRANSPORT_MODE_LABEL_R = "transportModeLabelR";
    public static final String TRANSPORT_MODE_LABEL_S = "transportModeLabelS";
    public static final String TERMS_OF_DELIVERY_LOCATION_LABEL =
        "termsOfDeliveryLocationLabel";
    public static final String TERMS_OF_DELIVERY_LOCATION_LABEL_P_L_D_Y =
        "termsOfDeliveryLocationLabelPLDY";
    public static final String TERMS_OF_DELIVERY_LOCATION_LABEL_P_L_D_N =
        "termsOfDeliveryLocationLabelPLDN";
    public static final String TERMS_OF_DELIVERY_LOCATION_LABEL_P_O_S_T =
        "termsOfDeliveryLocationLabelPOST";
    public static final String TERMS_OF_DELIVERY_LOCATION_LABEL_P_O_D_N =
        "termsOfDeliveryLocationLabelPODN";
}
```

(2) a `TermsOfDeliveryLabels.properties` file.

This file can be translated using standard `Java` I18N functionality.

```
codeLabel=Code
descriptionLabel=Description
exWorksLabel=Ex Works
transportModeLabel=Transport Mode
transportModeLabelA=Air
transportModeLabelA.icon=AIRPLANE
transportModeLabelI=Rail
transportModeLabelI.icon=TRAIN
transportModeLabelR=Road
transportModeLabelR.icon=TRUCK
transportModeLabelS=Sea
transportModeLabelS.icon=BOAT
termsOfDeliveryLocationLabel=TOD Location
termsOfDeliveryLocationLabelPLDY=Place of delivery
termsOfDeliveryLocationLabelPLDN=Place of destination
termsOfDeliveryLocationLabelPOST=Port of shipment
termsOfDeliveryLocationLabelPODN=Port of destination
```

Add `value types`

Every value-type generates a `Java` class, an abstract class (except for enumerates), and a `JPA` converter class.

(1) `Java` class

Generated Code

```
public class TermsOfDeliveryCode extends AbstractTermsOfDeliveryCode{①
    public TermsOfDeliveryCode(final String value) {
        super(value);
    }
}
```

① The abstract class implements the value-type, this concrete class only contains a constructor and can be moved to the manual source folder to add business logic.

Generated Code

```
public enum TransportMode implements DomainEnumerate{ ①

    AIR(EnumerateItem.create("A", "transportModeLabelA")) ,
    RAIL(EnumerateItem.create("I", "transportModeLabelI")) ,
    ROAD(EnumerateItem.create("R", "transportModeLabelR")) ,
    SEA(EnumerateItem.create("S", "transportModeLabelS"))
    ;

    public static EnumerateMeta meta = EnumerateMeta.create(
        AIR.item,
        RAIL.item,
        ROAD.item,
        SEA.item
    );
    ...
}
```

① Java enum does not support inheritance, so there is only a concrete class

(2) The Converter class provides a mapping between the database value and the value-type.

Generated Code

```
@Converter(autoApply = false)
public class TermsOfDeliveryCodeConverter
    implements AttributeConverter<TermsOfDeliveryCode, String> {

    @Override
    @NonNull public String convertToDatabaseColumn(
        @Nullable final TermsOfDeliveryCode attribute) {①

        if(attribute!=null) {
            return attribute.getValue();
        }
        return "";
    }

    @Override
    @NonNull public TermsOfDeliveryCode convertToEntityAttribute(
        @Nullable final String dbData) {②

        if(dbData!=null) {
            return TermsOfDeliveryCode.of(dbData);
        }
        return TermsOfDeliveryCode.EMPTY;
    }
}
```

① convert value type TermsOfDeliveryCode to a database string

② convert a database string to a `TermsOfDeliveryCode`

Add `entity`

The entity declaration creates a concrete entity class, an abstract entity class and two classes for setting operational- and user-fields.

Generated Code

```
@Access(AccessType.FIELD)
@Entity
@Table(name="com_log_termsofdelivery" ①
,uniqueConstraints=@UniqueConstraint(columnNames={"code"}) ②
)

public class TermsOfDelivery extends AbstractTermsOfDelivery{ ③

    // Protected constructor required by Hibernate
    protected TermsOfDelivery(){
        super();
    }

    public TermsOfDelivery(
        @NonNull final TermsOfDeliveryCode code,
        @NonNull final Description description,
        @NonNull final TermsOfDeliveryLocation termsOfDeliveryLocation
        ){

        super(
            code,
            description,
            termsOfDeliveryLocation
        );
    }
}
```

① Class name is converted into a database table name.

② The business key is converted into a uniqueness constraint

③ The abstract class implements the entity, this concrete class only contains a constructor and can be moved to the manual source folder to add business logic.

The entity class is by default read-only, all the `setters` are contained in a specialized `user` class for user-fields, and `update` class for operational fields.

Add `view-model`

Generated Code

```
@ViewModelComponent
public class TermsOfDeliveryViewModel extends AbstractTermsOfDeliveryViewModel{①
}
```

① The abstract class implements the `view-model`, this concrete class is empty and can be moved to the manual source folder to add business logic.

Client side project

Add `grid`

The generated `Java` code uses a grid-builder to create the layout. Constants are added for all form-fields that can be referenced in custom page logic.

Generated Code

```
public class TermsOfDeliveryGrid{

    @NonNull public static final String CODE = "code";
    @NonNull public static final String DESCRIPTION = "description";
    @NonNull public static final String TRANSPORT_MODE = "transportMode";
    @NonNull public static final String TERMS_OF_DELIVERY_LOCATION =
        "termsOfDeliveryLocation";
    @NonNull public static final String EX_WORKS = "exWorks";

    public static <T> GridBuilder<T> create(final GridBuilder<T> builder)①
        throws ClientException{

        builder
        .add(CODE)
        .add(DESCRIPTION)
        .add(TRANSPORT_MODE)
        .add(TERMS_OF_DELIVERY_LOCATION)
        .add(EX_WORKS)
        ;

        return builder;
    }
}
```

① the grid builder input parameter

Add `form`

The generated `Java` code uses a form-builder to create the layout. Constants are added for all form-fields that can be referenced in custom page logic.

Generated Code

```
public class TermsOfDeliveryForm{

    @NonNull public static final String CODE = "code";
    @NonNull public static final String DESCRIPTION = "description";
    @NonNull public static final String TRANSPORT_MODE = "transportMode";
    @NonNull public static final String TERMS_OF_DELIVERY_LOCATION
        = "termsOfDeliveryLocation";
    @NonNull public static final String EX_WORKS = "exWorks";

    public static <T> FormBuilder<T> create(final FormBuilder<T> builder)
        throws ClientException{

        builder
        .beginSection()
            .addField(CODE)
            .addField(DESCRIPTION)
            .nextColumn()
            .addField(TRANSPORT_MODE)
            .addField(TERMS_OF_DELIVERY_LOCATION)
            .addField(EX_WORKS)
        .endSection();
        return builder;
    }
}
```

Add page

The page declaration generates an concrete Java class with only a constructor, and an abstract Java class with the page logic.

Generated Code

```
@PageTitle("TermsOfDeliveryPage")
@Page
public class TermsOfDeliveryPage extends AbstractTermsOfDeliveryPage{

    public TermsOfDeliveryPage(
            @Autowired final PageService pageService,
            @Autowired final VComponentService componentService)
            throws ClientException{

        super(pageService, componentService);

        initialize();
    }

}
```

The abstract page class can extend any Vaadin page component.

Generated Code

```
@Route(value = "termsOfDeliveryPage", layout = VMainLayout.class)
@PermitAll
public class AbstractTermsOfDeliveryPage extends Div implements HasViewModel{
...
}
```

It declares the view-model and views.

Generated Code

```
protected final DefaultClientViewModel todViewModel;

protected final VGridBuilder termsOfDeliveryGridBuilder;
protected final VFormBuilder termsOfDeliveryFormBuilder;

protected final AclAuthorization pageAuthorization;
```

and instantiates them in the constructor.

Generated Code

```
public AbstractTermsOfDeliveryPage(
    @Autowired final PageService pageService,
    @Autowired final VComponentService componentService) throws ClientException{

    todViewModel = pageService.createViewModel(
        TOD_VIEW_MODEL_NAME,
        getViewModelAuthorization(TOD_VIEW_MODEL));

    termsOfDeliveryGridBuilder = componentService
        .createGridBuilder(todViewModel)
        .append(TermsOfDeliveryGrid::create);

    termsOfDeliveryFormBuilder = componentService
        .createFormBuilder(todViewModel)
        .append(TermsOfDeliveryForm::create);

    termsOfDeliveryFormBuilder.addDefaultToolbar();
}
```

finally the page is constructed using a page-builder.

Generated Code

```
protected VPageBuilder createPageBuilder() throws ClientException{

    final VPageBuilder pageBuilder = componentService.createPageBuilder();
    pageBuilder.addTitleLabel("termsOfDeliveryLabel");

    pageBuilder
    .beginSegment("termsOfDeliveryLabel")
        .add(termsOfDeliveryGridBuilder.build())
        .add(termsOfDeliveryFormBuilder.build())
    .endSegment();

    return pageBuilder;
}
```

Add `menu`

Generated Code

```
@Service
public class Menu_com_log{

    private final LabelProvider labelProvider;

    @Inject
    public Menu_com_log(final LabelProvider labelProvider) {
        super();
        this.labelProvider = labelProvider;
    }

    ...

    public void addItems(
            final HasMenuItems hasMenuItems,
            final MenuSelectionHandler handler) {

        hasMenuItems.addItem(
            labelProvider.getLabel("COM_Labels.numberSeriesLabel")①
            .getDescription(),
            (e)->handler.openPage("numberSeriesPage"));

        hasMenuItems.addItem(
            labelProvider.getLabel("COM_Labels.termsOfDeliveryLabel")
            .getDescription(),
            (e)->handler.openPage("termsOfDeliveryPage"));

        hasMenuItems.addItem(
            labelProvider.getLabel("COM_Labels.uomLabel")
            .getDescription(),
            (e)->handler.openPage("uOMPage"));
    }
}
```

① Use of constants is not required as menus can not be sub-classed.

Core concepts

One language

An organization with limited resources is best served with the simplicity of one programming language. For Wercstat this means Java, both server-side and client-side. This simplifies training and hiring of developers.

Nonetheless, it is still possible to integrate with client-side languages or frameworks like JavaScript, Angular, Vue or React if required.

Less code

Less code means less hours spent on development and testing, less bugs, less legacy and less maintenance. In practice this means higher productivity, lower cost of ownership, better quality and agility.

But some code can not be avoided, in that case the best alternative is to generate code where possible. Wercstat generates code according to strict architectural patterns, improving code discoverability and preventing code duplication.

Generated code is not part of the application source-code, it does not need maintenance and can be automatically updated when required, for instance to include new technologies.

Business Developers

Wercstat supports both Business Developers and Technical Developers.

Business Developers use high level abstractions, comparable to 4GL languages, to implement business functionality. They do not need to know all the technical details of Java, only enough to code user requirements.

Technical Developers know the Java language in all its technical details. They develop more specialized requirements like web-services, custom UI components (e.g. plan-board) and interfaces with external systems (barcode-scanners, SCADA, etc.).

Everything is text

All application components are defined and stored in simple text files. This includes business-logic, entity definitions, user interfaces, external dependencies and documentation.

Benefits:

Future Proof

Text is the most open, accessible and future proof format.

Version Control

Database structures, dependencies and documentation are stored and versioned (GIT) together with

the business code.

Code close to the business

Not only business entities are represented in code, but also primitive Java types (Boolean, String, BigDecimal, etc.) are replaced with business concepts like Confirmed, Document and Amount.

Benefits:

Better communication

The same business-terms (e.g. Price, Rate, OrderLine) are used both in the specification and the source code. This narrows the communication gap between developers and domain experts.

Error prevention

Improved type checking during development will catch errors early. A Price is different from an Amount, a CustomerReference is different from a Description. These differences are checked at development-time.

Compare this with Java primitive types, where all business-concepts are represented by the same set of primitive types and mistaking a document-code for a reference-number only become apparent when tests fail.

User interaction is business logic

Most user-interaction is handled on the server side, as part of the business logic. For example the visibility of fields and buttons, making fields editable or read-only, amending user input, setting field defaults, opening selection-screens, adding grid filters and showing error messages. All is handled server-side.

Benefit:

UI logic is business-logic, and implementing it on the server side makes it possible to change UI technology in the future, if needed.

Develop at all levels of abstraction

Wercstat allows developers to work at all levels of abstraction, from the Wercstat-DSL down to plain Java. Anything the Werstat DSL provides, can also be achieved using plain Java.

A good example are the abstraction levels available for building UI's.

Abstraction level 4*: UI* DSL

Developers can create pages, grids, forms and menus using the extensive Wercstat-DSL.

The DSL internally uses Java UI-builders. These UI-builders are also available for developers if they need more control.

Abstraction level 3*: UI builders*

Developers can create pages, grids, forms and menus using UI-builders.

The UI-builders internally use Wercstat component-factories to create UI-components, and component-binders to connect these to the client-side view-model. These component-factories and component-binders are also available for developers if they need more control.

Abstraction Level 2*: UI component-factories and component-binders*

Developers can create pages, grids, forms and menus using component-factories and component-binders.

The Wercstat component-factories internally use Vaadin components, and the component-binders listen to view-model events to bind them together. These Vaadin components and client view-model events are also available for developers if they need more control.

Abstraction Level 1*: UI Vaadin components and view-model events*

Developers can create pages, grids, forms and menus can by using Vaadin components and connecting them to the view-model by listening to view-model events.

Abstraction Level 0*: Custom solution*

Developers can choose not to use the Wercstat framework and create a custom solution on top of the industry-standard Java and Spring stack.

Benefit:

The developer is not restricted in any way, and can choose the abstraction that matches the level of control needed.

Anywhere between 80% and 100% of the user interface will be created using the Wercstat-DSL. But for those special screens, which are important to the client, the UI can be customized at any level down to Javascript in the browser.

And of course, different levels of abstraction can be combined within a single UI page.

No null-pointer exceptions

Nullability

Nullability annotations are implemented throughout the framework, including generated code. This eliminates not only null-pointer exceptions but also the need to add null-checks or assertions in business code.

When using external libraries, null-pointer exceptions can still occur.

Entity Construction

Entity constructors, getters and setters have Nullability annotations for parameters and return values. If an entity field is mandatory, the getter will return a @NonNull value, and the setter will take a @NonNull parameter. And if the field is not calculated, a @NonNull parameter is added to the constructor to ensure that no instance of the entity can be created without a valid field value.

Benefit:

Null-pointer exception is the most prevalent error in Java applications. Eliminating it greatly improves the application stability and ultimately user experience.

Minimal vendor lock-in

Wercstat only depends on industry standard open source components which are widely used and supported by commercial companies.

Wercstat also aims to reduce its own vendor lock-in as much as possible. Most business logic can be developed with no dependency on the Wercstat framework.

Entities, repositories and value-types depend only on the com.wercstat.domain submodule. This dependency can be easily replaced by bespoke code or libraries from other vendors.

The user interaction (UI) logic is more dependent on the framework. Replacement with other UI solutions is manageable, but will need effort depending on the target platform.

And of course, everything is text, no proprietary formats or structures stored in obscure database tables.

Benefit:

A lower threshold to start using the Wercstat framework, and the future ability to switch should the need occur.

Commercial Support

Wercstat is a complex framework for a specialized market. Stability, continuity and innovation is essential for customers.

The fact that Wercstat is a commercially viable product, has a loyal customer base and has a sixteen year track-record, guarantees continuity and long term support.

Benefit:

Wercstat systems will stay up-to-date with modern technology. No more big-bangs or application rewrites.

Wercstat-ERP

Overview

The example application presented here is Wercstat-ERP and is built using the Wercstat-Framework. Over time this application will replace a legacy InforLN ERP system by incrementally moving functional modules from InforLN to Wercstat-ERP. During this process a robust integration with the existing ERP system is key.

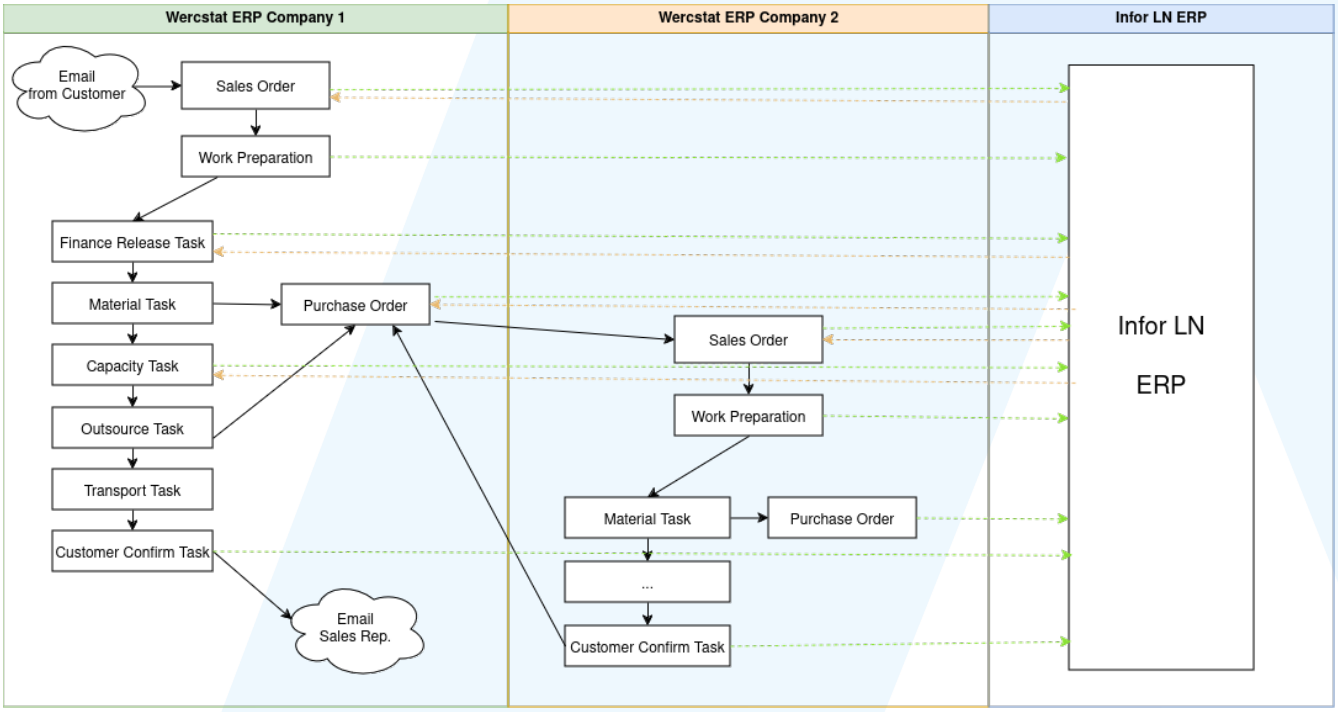
Functionality

Central to the application are the order entry and planning modules.

Sales orders are created automatically based on either B2B messages, or PDF order-confirmations received by email. If needed sales representatives can amend the order, with the PDF and mail information available in Wercstat-ERP.

Once the order is confirmed it is forwarded to the legacy ERP system, and a work-preparation document is created in Wercstat-ERP.

The work-preparation document contains tasks for the planning of materials, production-capacity, outsourcing and transport. Once the planning is completed, including inter-company purchases, the sales representative is informed by email. The email contains the planning details and a direct HTTP link to the sales order in Wercstat-ERP.

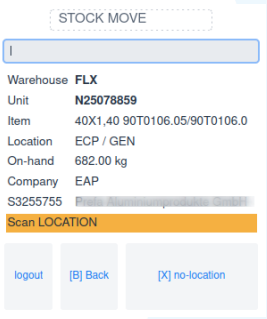


When the module was first build most tasks were completed manually by end users. Over time more and more tasks are handled by background jobs, based on lead-time calculation rules.

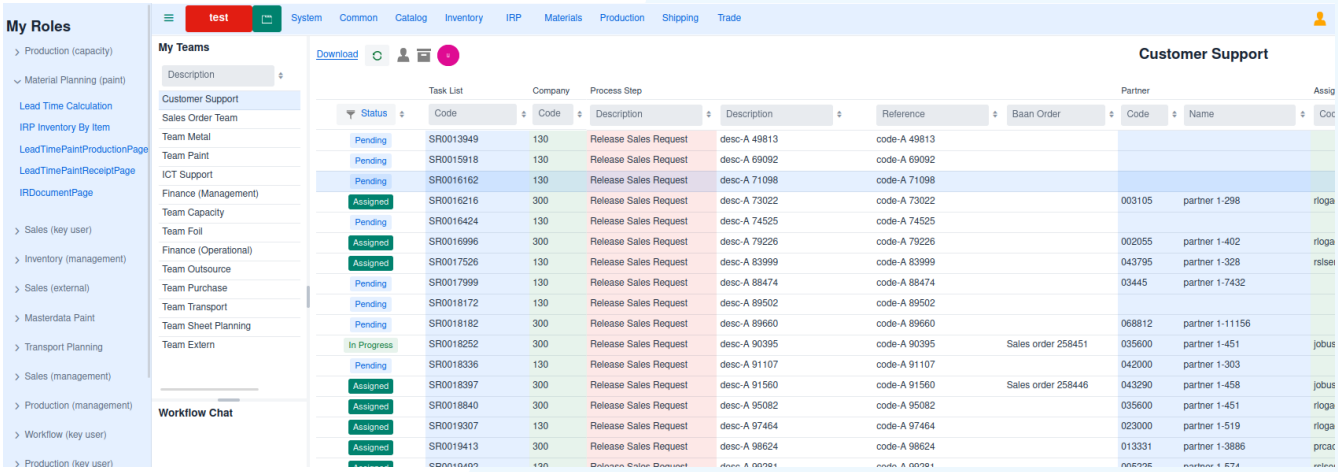
All sales and purchase orders, together with the production planing, are fed into the legacy InforLN ERP system.

The Wercstat DSL was extended to generate InforLN application interfaces (APIs).

The starting page is configured per user-group. Forklift drivers for example start with the scanning page on their mobile device:



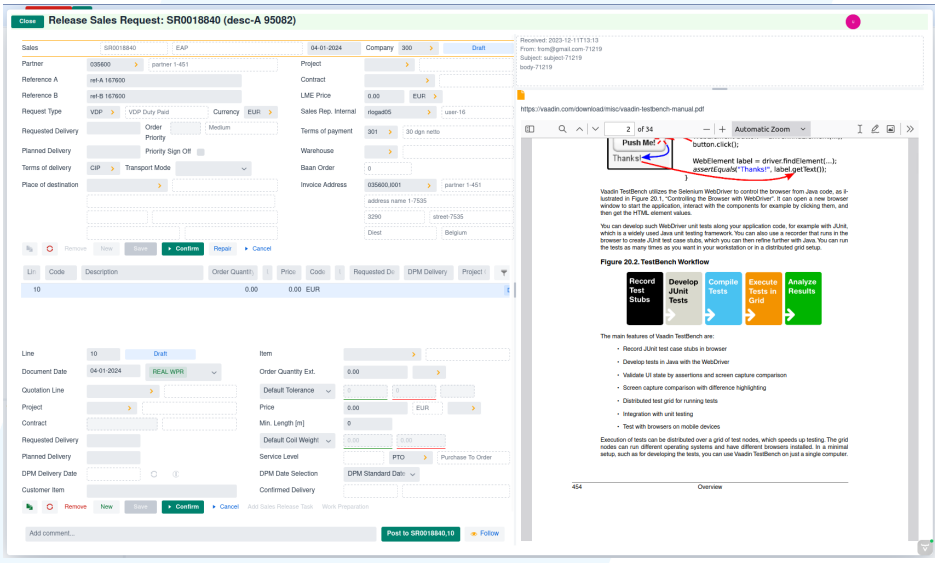
Office users start with the workflow task screen:



Desktop pages have a collapsible section on the left with the roles of the user.

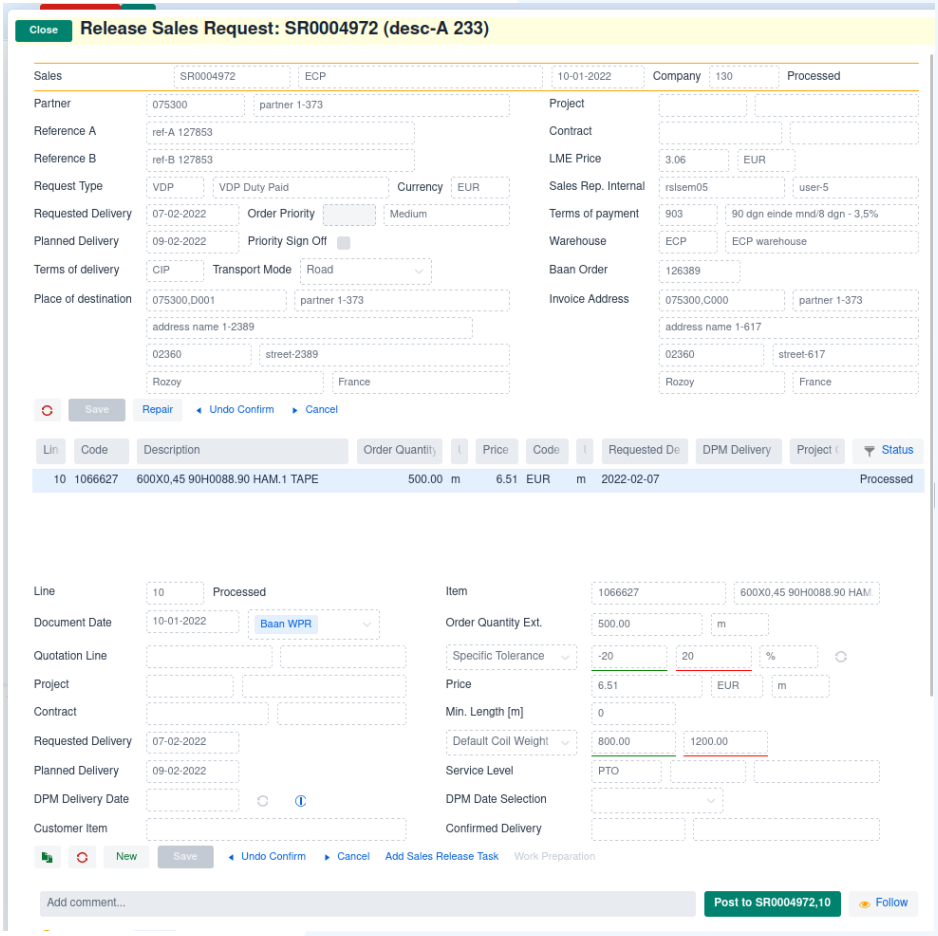
Next is the workflow page with on the left a list of all teams that the user is a member of, and finally a list with pending tasks.

Double-clicking a task-line of the customer support team will open the sales order.

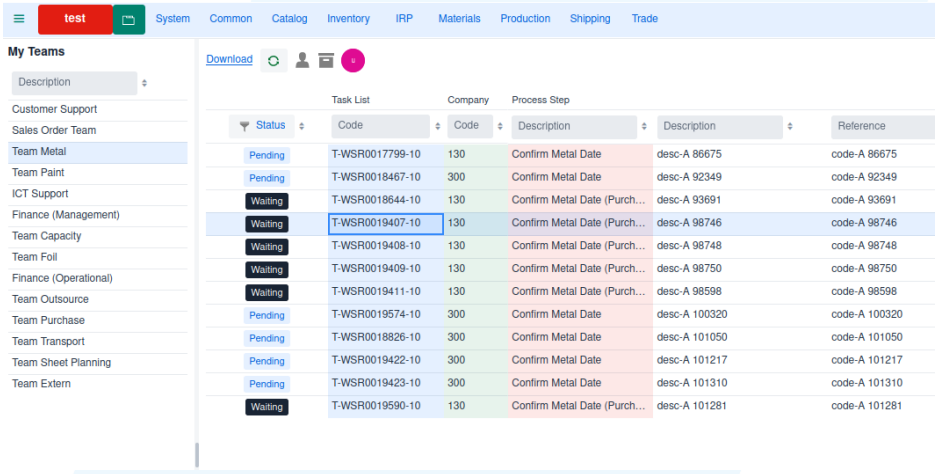


All fields are editable and the confirm button is available. This changes the moment the order is

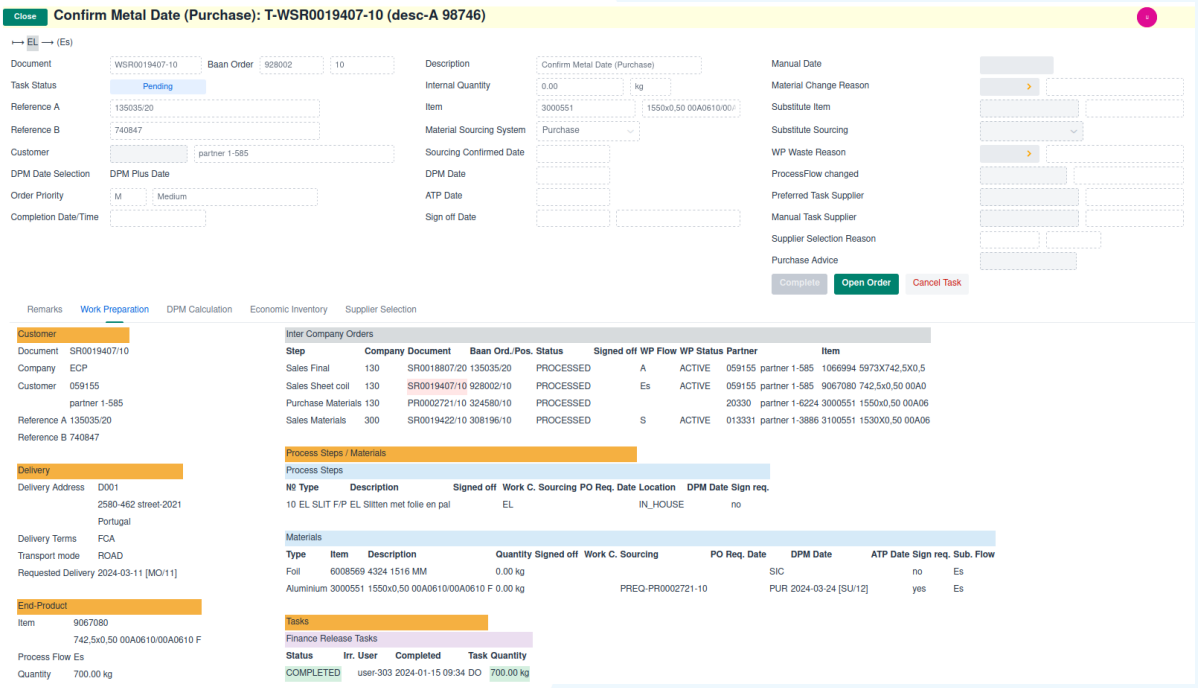
confirmed.



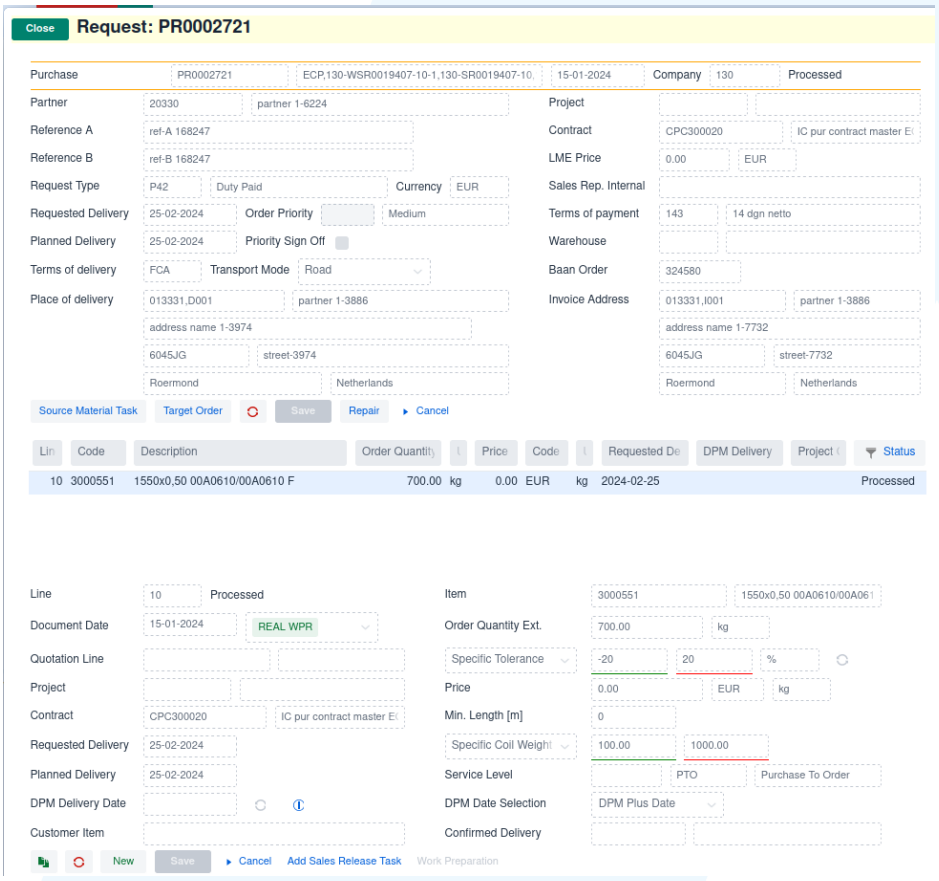
Once the sales order is confirmed, the work preparations starts and workflow-tasks are created. The `metal waiting` task is the result of input material that has to be purchased inter-company.



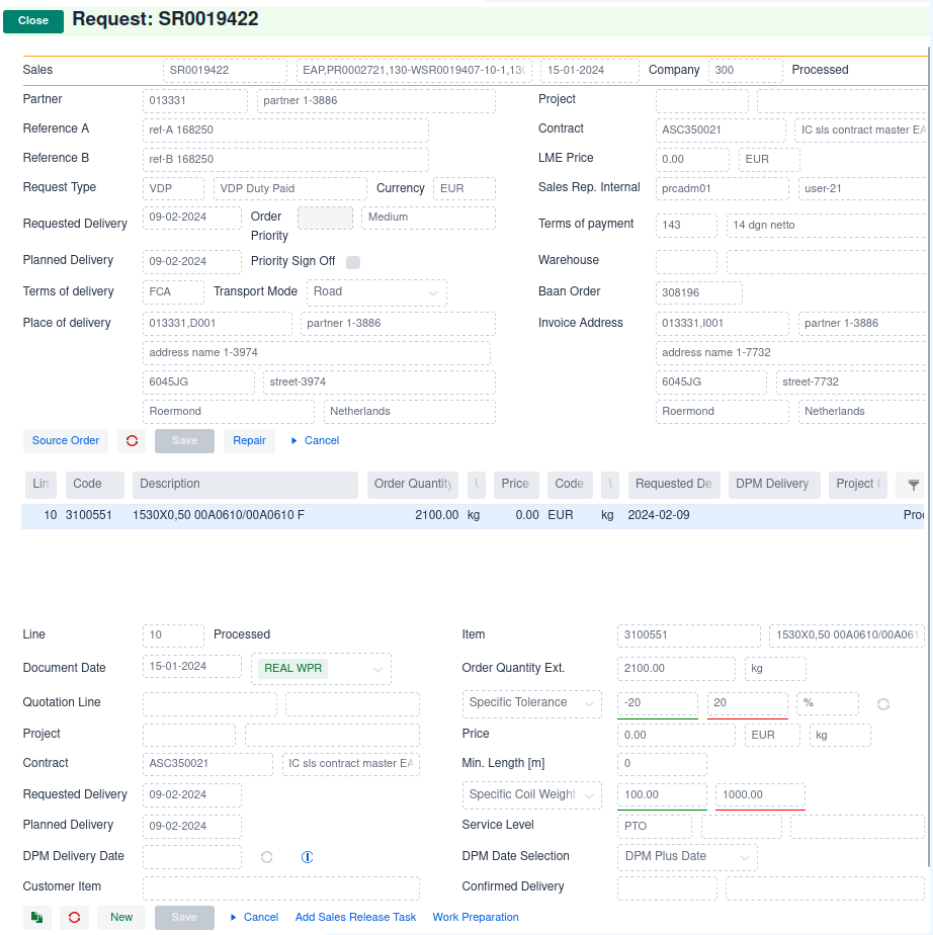
Double clicking the `metal waiting` task will open the task page.



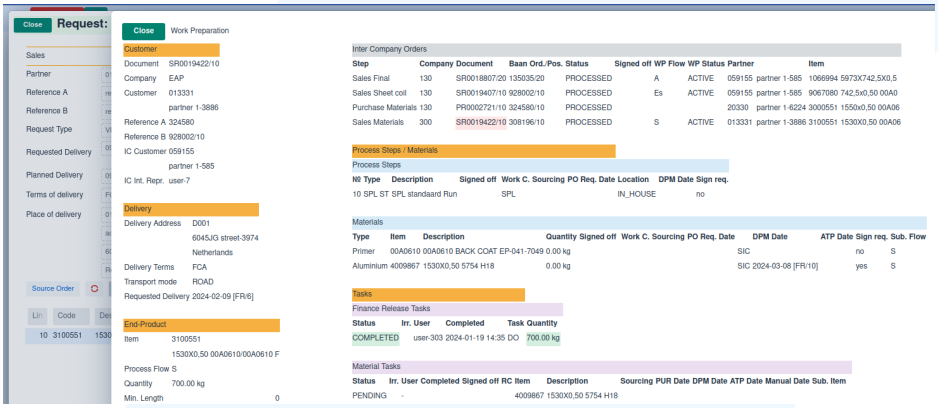
The material task is linked to a purchase order. Selecting the `Open Order` button displays the purchase order.



As this is an inter-company purchase, the order generates a sales order in the supplying company. Selecting the `Target Order` button displays the inter-company sales order.

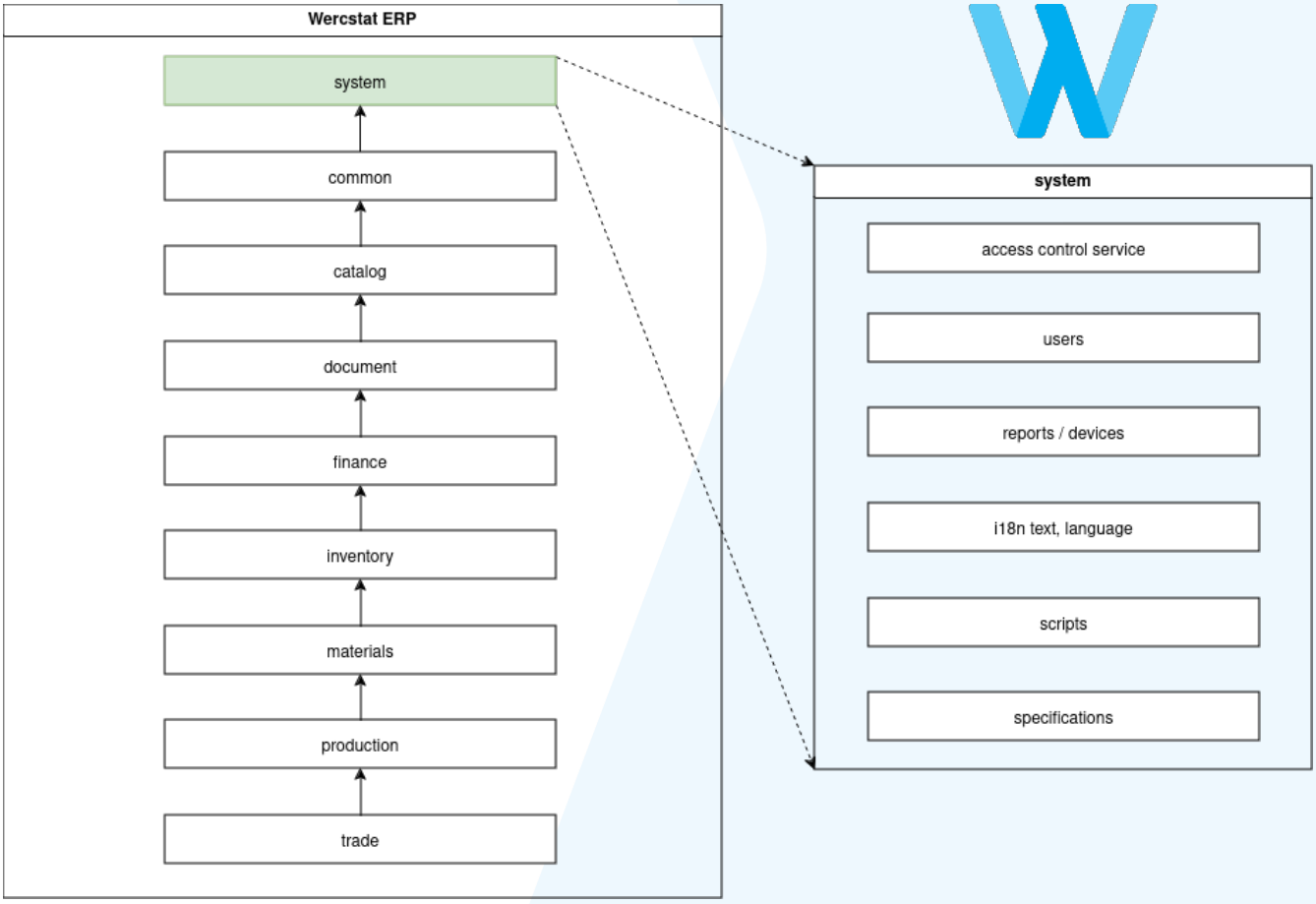


Subsequently, in the supplying company a new work-preparation process is started, with all the tasks required to produce the requested material.



Implementation

`Wercstat-ERP` consists of nine main modules with strict uni-directional dependencies. For example, module `production` can refer to `materials` or `finance`, but can not reference module `trade`.



Projects

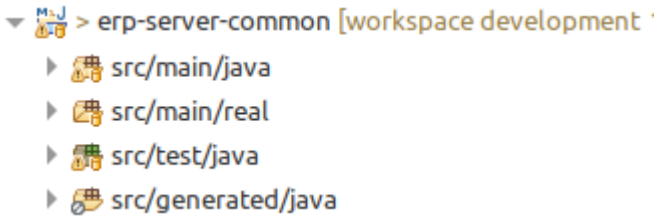
The Wercstat-ERP main modules are implemented as Eclipse code-projects

- erp-parent [workspace development]
- erp-server-catalog [workspace development]
- erp-server-common [workspace development]
- erp-server-document [workspace development]
- erp-server-finance [workspace development]
- erp-server-inventory [workspace development]
- erp-server-material [workspace development]
- erp-server-production [workspace development]
- erp-server-quality [workspace development]
- erp-server-system [workspace development]
- erp-server-trade [workspace development]

There are additional Eclipse projects for documentation (ascidoc) and deployment (maven).

Folders

Every Eclipse project has source-folders for manual Java-code (.java files), generated Java-code and domain-model files (.real files).

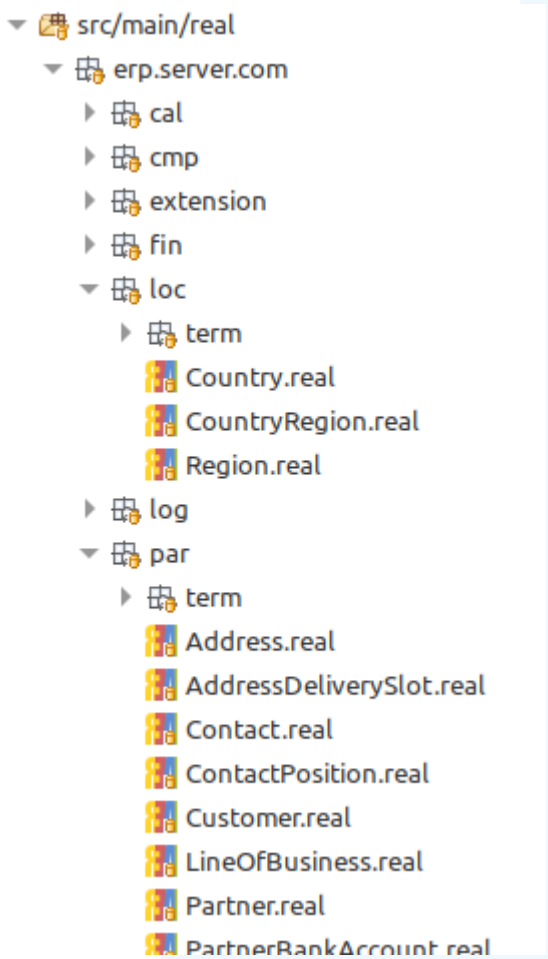


Source folder	Content
`src/main/java`	business logic
`src/main/real`	domain model
`src/test/java`	automated tests
`src/generated/java`	database and UI `Java` code, derived from the domain model

`Wercstat` automatically generates all `Java` code for database and UI interaction, based on the domain model. The generated code is placed in the **src/generated/java** package, outside the view of the developer.

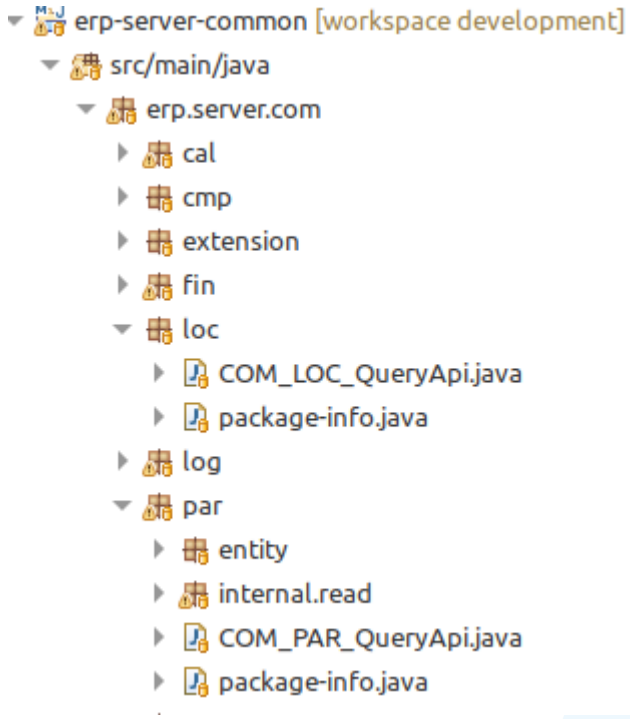
Domain Model

The domain model is structured around organizational modules and submodules. It consists of `.real` files which define entities, forms, grids, pages, menu's, etc.



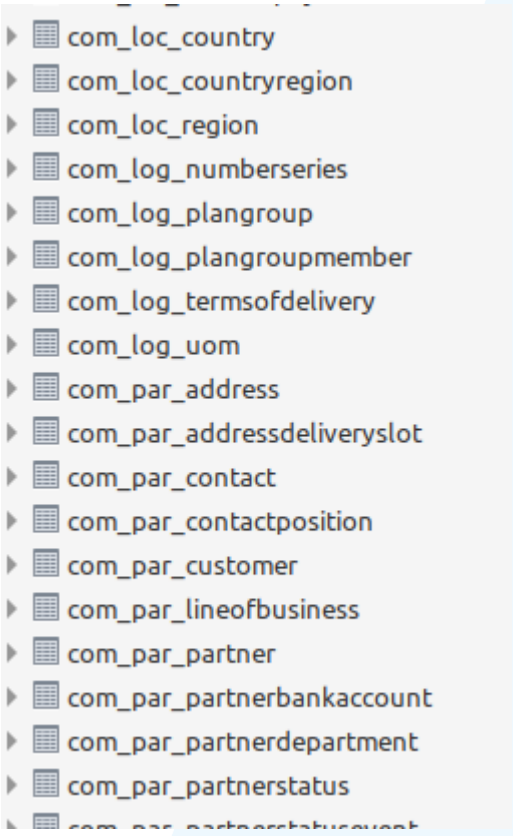
Packages

The Java code automatically follows the domain model structure.



Tables

The same applies to the automatically generated database tables:



The end-result is a consistent ERP application where business logic is clearly structured and maintainable, even when it grows to hundreds of entities.

Although discouraged, you **can** use alternative table and table-field names.

Code Structure

Modules

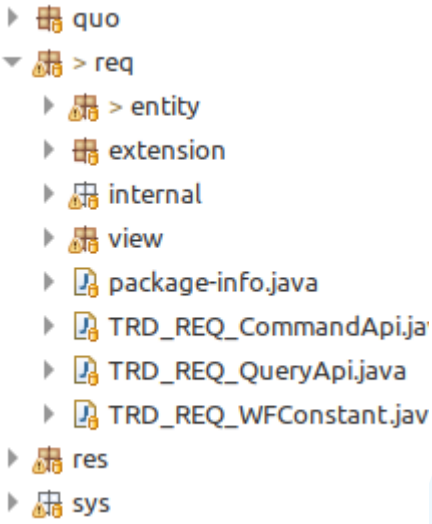
`Wercstat-ERP` packages have the following structure:

`com.wercstat.erp.server.<module>.<submodule>` or

`com.wercstat.erp.client.<module>.<submodule>`

for example `com.wercstat.erp.server.trd.req` and `com.wercstat.erp.client.prd.pln`

Every sub-module has a fixed set of sub-packages and classes.



Public module API

The main sub-package of every module exposes the public interface (`API`).

This includes sub-packages:

- `entity` : contains all module entities
- `extension` : contains interfaces that module entities can implement
- `view` : contains all module `view-models`

and the following public classes:

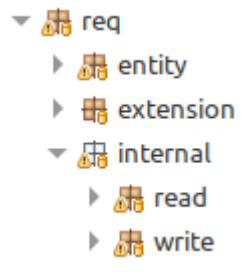
- `TRD_REQ_CommandApi` : is a facade to module business functionality where data is updated
- `TRD_REQ_QueryApi` : is a facade to module business functionality where data is read
- `TRD_REQ_Constant` : public module constants

External modules can only access packages or classes from the public `API`.

Private module implementation

The `internal` sub-package contains the actual implementation of business logic and is not accessible from outside the module.

As in the public `API` (`TRD_REQ_CommandApi`, `TRD_REQ_QueryApi`) the internal business logic is divided into a `read` and `write` sub-package.



Read / Write separation

`Write` methods update the database and can have side-effects in the system. They often contain the majority of the critical to business logic.

`Read` methods have no side effects and often contain less business logic.

By separating updates from reads (and commands from queries), it is easier to reason about the interaction between modules.

For example: finding modules that call write methods in sub-module `prd.wpr`.

With `Eclipse` search functionality it is easy to see that update methods in the sub-module `prd.wpr` are only called from sub-module `trd.req` and `prd.irr`.

In this case that makes sense because only sales orders (`trd.req`) and production irregularities (`prd.irr`) can update work preparation (`prd.wpr`).

For example: see what modules are updated by business methods.

Considerer the supporting services that the following `Java` class declares:

```
@Service
public class MRequestLineActionWriter {

    private final DOC_COM_CommandApi doc_com_CommandApi;
    private final PRD_WPR_CommandApi prd_wpr_CommandApi;

    private final COM_PAR_QueryApi com_par_QueryApi;
    private final PRD_BAS_QueryApi prd_bas_QueryApi;
    private final PRD_WPR_QueryApi prd_wpr_QueryApi;
    ...

}
```

It is instantly clear that this method only updates the `doc.com` and `prd_wpr` sub-modules.

Again in this case it makes sense, because the class contains actions from the sales line web-page. And the sales line calls `doc.com` for a new sales order number (which updates the number-series), and calls `prd.wpr` to start work-preparation.

Should there be any other `CommandApi` services, then this might indicate architectual issues.

Rule enforcement

`Wercstat-ERP` enforces the architectual rules using `archunit` (https://www.archunit.org/). Part of these rules are automatically generated by the `Wercstat-ERP` module structure.

And for general code quality, `ErrorProne` (https://errorprone.info/) static checks have been added to the build process.

Order Entry Page

One of the UI pages in the `trade` project, is used for sales-order entry:

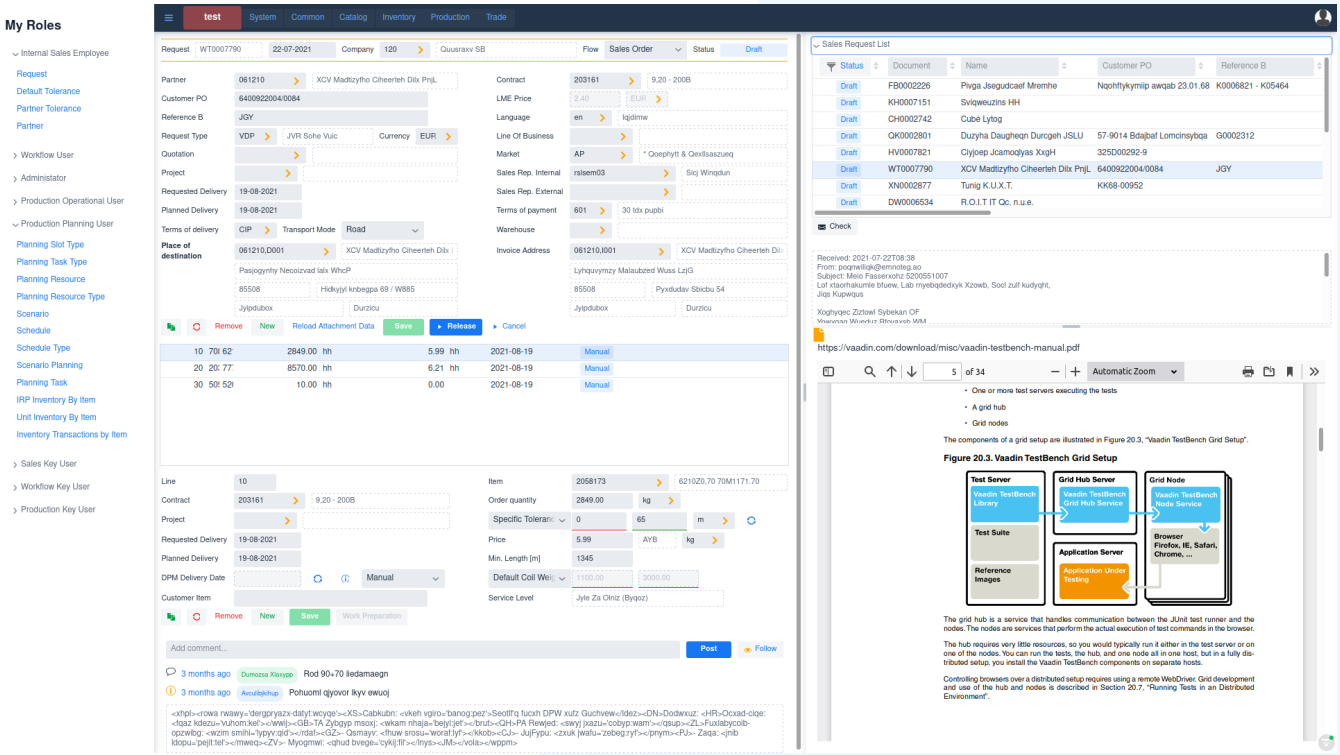


Figure 3. Order Entry Page

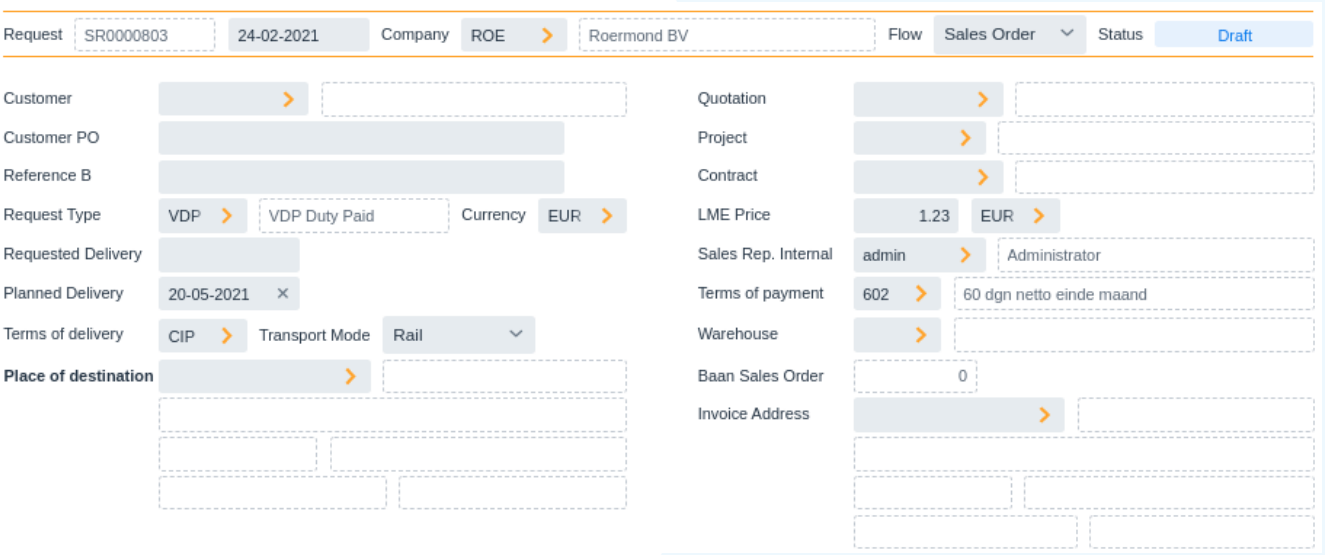
This page manages content form five different database tables:

1. Sales Order
2. Sales Order Line
3. User Comments
4. Mail Message
5. Mail Message Attachments

All interaction between the UI components, and the interaction with the server-side `view-models` is handled by the `Wercstat` framework.

Form

The top left form in the `Order Entry Page` contains the order-header:



The complete form declaration using the DSL is as follows:

```
form MRequestForm
{
    viewmodel MRequestViewModel

    row header {
        label-code mRequestLabel
        value documentCode
        value documentDate
        field company
        value company/description
        field requestType
        field biRequestStatus
    }

    field partner [name]

    field referenceA
    field referenceB

    label requestType
    row {
        value requestType
        value requestType/description
        field currency
    }

    field requestedDeliveryDate
    field plannedDeliveryDate

    label termsOfDelivery
    row {
        value termsOfDelivery
        field transportMode
    }
```

```
    value-label termsOfDelivery/termsOfDeliveryLocation
    row {
        value deliveryAddress
        value deliveryAddress/partner/name
    }
    tab value deliveryAddress/name1
    tab row {
        value deliveryAddress/zipcode
        value deliveryAddress/street
    }
    tab row {
        value deliveryAddress/city
        value deliveryAddress/country/description
    }

    next-column

    field quotation [description]
    field project [description]
    field contract [description]

    label lmePrice
    row {
        value lmePrice
        value lmeCurrency
    }

    field representativeInt [name]
    field termsOfPayment [description]
    field warehouse [description]
    field baanOrno

    label invoiceAddress
    row {
        value invoiceAddress
        value invoiceAddress/partner/name
    }
    tab value invoiceAddress/name1
    tab row {
        value invoiceAddress/zipcode
        value invoiceAddress/street
    }
    tab row {
        value invoiceAddress/city
        value invoiceAddress/country/description
    }

}
```

The form declaration uses the following key-words:

row { <fieldList> }	marks a list of fields which are displayed on the same row
label <fieldName>	display the **label** of `view-model` field <fieldName>
value <fieldName>	display the **value** of a `view-model` field <fieldName>
field <fieldName>	display both the **label** and the **value** of a `view-model` field <fieldName>
tab	skip the label or value column

Header Row

Let's look in more detail, beginning with the header row:

defined as follows:

```
row header { ①
    label-code mRequestLabel ②
    value documentCode ③
    value documentDate ④
    field company ⑤
    value company/description ⑥
    field requestFlow ⑦
    field biRequestStatus ⑧
} ⑨
```

① start a list of fields and labels that are displayed as one row.

② display the **label** with code `mRequestLabel`. This will display `Request`.

③ display the **value** of the `documentCode` field. This will display `SR0000803`.

④ display the **value** of the `documentDate` field. This will display `24-02-2021`.

⑤ display the `company` **field**. This will display `Company` and `ROE`.

⑥ display the **value** of the `company/description` field. This will display `Roermond BV`.

⑦ display the `requestFlow` **field**. This will display `Flow` and `Sales Order`.

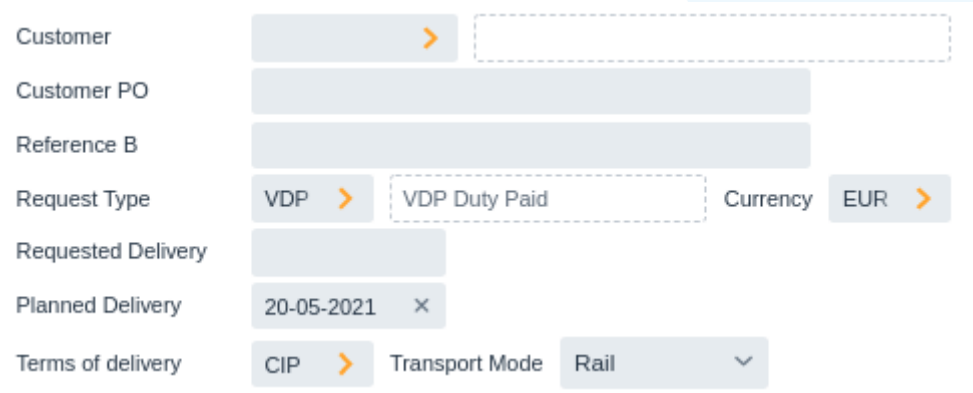
⑧ display the `biRequestStatus` **field**. This will display `Status` and `Draft`.

⑨ end the list of row fields

Left Column

Part 1

Next the first part of the left column:




```
field partner [name] ①

field referenceA ②
field referenceB

label requestType ③
row { ④
    value requestType
    value requestType/description
    field currency
}

field requestedDeliveryDate ⑤
field plannedDeliveryDate

label termsOfDelivery ⑥
row {
    value termsOfDelivery
    field transportMode
}
```

① Display the `partner` field, followed by `partner/name`. This will display label `Customer`, the customer input field and the customer name. The square brackets `[]` are a special short-cut making it easier to add foreign-entity fields.

② Add the `refrenceA` label and value.

③ Add only the label `requestType`.

④ Start a row of fields, containing the value of `requestType`, the value of `requestType/description`, and the label and value of `currency`.

⑤ Display the label and value of `requestedDeliveryDate` and `plannedDeliveryDate`

⑥ Add label of field `termsOfDelivery`, and display a row with the value of `termsOfDelivery` and both the label and value of `transportMode`.

Part 2

The second part of the left column simply displays an address:

```
value termsOfDelivery/termsOfDeliveryLocation ①
row { ②
    value deliveryAddress
    value deliveryAddress/partner/name
}
tab value deliveryAddress/name1 ③
tab row { ④
    value deliveryAddress/zipcode
    value deliveryAddress/street
}
tab row { ⑤
    value deliveryAddress/city
    value deliveryAddress/country/description
}

next-column ⑥
```

① `termsOfDelivery/termsOfDeliveryLocation` displays the location belonging to the terms of delivery.

② add a row with the `deliveryAddress` input field, and partner-name belonging to the address

③ display `name` field of the delivery address itself.

④ display `zipcode` and `street` of the delivery address.

⑤ display `city` and `countr/description` of the delivery address.

⑥ start a new column

The right column uses all the same concepts and should be self explanatory.

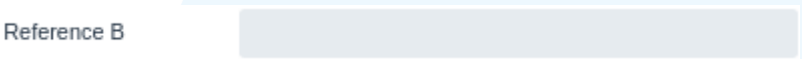
Label and value subcolumns

Note that columns are subdivided into a *label* sub-column and a *value* sub-column. This allows easy alignment of field-values and make the form easier to read.

For example:

```
field referenceB
```

displays the label in the label-column, and field value in the value-column:



```
label termsOfDelivery
row {
    value termsOfDelivery
    field transportMode
}
```

displays the `termsOfDelivery` label in the label-column, and the field `termsOfDelivery` and `transportMode` in the value-column:

```
tab row {
    value deliveryAddress/zipcode
    value deliveryAddress/street
}
```

skip the label-column, and displays zipcode and street in the value-column:

Generated Code

The generated code is more verbose, but still easy to understand:

Generated Code

```
public static <T> FormBuilder<T> create(final FormBuilder<T> builder) throws
ClientException{

    builder
    .beginSection()
        .beginCell(FormCellType.HEADER)
            .addValueReadOnly(REQUEST_TYPE_MTYPE)
            .addValue(DOCUMENT_CODE)
            .addValue(LINKED_DOCUMENTS)
            .addValue(DOCUMENT_DATE)
            .addField(COMPANY)
            .addValue(BI_REQUEST_STATUS)
        .endCell()
        .addField(PARTNER,"name")
        .addLabel(REFERENCE_A_LABEL)
        .beginCell(FormCellType.LINE)
            .addValue(REFERENCE_A)
            .addValue(REFERENCE_WARNING)
            .cssClass("real-field-warning")
        .endCell()
        .addField(REFERENCE_B)
        .addLabel(REQUEST_TYPE_LABEL)
        .beginCell(FormCellType.LINE)
            .addValue(REQUEST_TYPE)
            .addValue(REQUEST_TYPE_DESCRIPTION)
            .addField(CURRENCY)
        .endCell()
        .addLabel(REQUESTED_DELIVERY_DATE_LABEL)
        .beginCell(FormCellType.LINE)
            .addValue(REQUESTED_DELIVERY_DATE)

        ...
}
```

Deployment

`Wercstat-ERP` has so called `xcopy deployment`, which means you can simply copy application files to a server-directory and start the application. Providing the server has `Java` runtime-edition installed.

The directory only needs two files; the application itself `erp-trade-client-1.6.7.jar` and a file with settings `application.properties`.

Create the `JAR` artifact

The `Maven POM` has a special `production` profile for deployment in production environment.

```
mvn install -Pproduction
```

This profile adds code optimization and packaging for front-end artifacts. Execute the `trade-client-install (production)` launch to create the deployment Java archive file (JAR-file).

```
[INFO] ------------------------------------------------------------------------
[INFO] Reactor Summary for ERP Parent 1.6.7:
[INFO]
[INFO] ERP Parent ......................................... SUCCESS[  0.235 s]
[INFO] ERP Shared ......................................... SUCCESS[  0.503 s]
[INFO] ERP System Server .................................. SUCCESS[  7.656 s]
[INFO] ERP Common Server .................................. SUCCESS[  6.975 s]
[INFO] ERP Catalog Server ................................. SUCCESS[  4.912 s]
[INFO] ERP Document Server ................................ SUCCESS[  3.044 s]
[INFO] ERP Finance Server ................................. SUCCESS[  1.409 s]
[INFO] ERP Inventory Server ............................... SUCCESS[  3.512 s]
[INFO] ERP Quality Server ................................. SUCCESS[  1.263 s]
[INFO] ERP Warehousing Server ............................. SUCCESS[  1.389 s]
[INFO] ERP Material Server ................................ SUCCESS[  4.173 s]
[INFO] ERP Production Server .............................. SUCCESS[  9.909 s]
[INFO] ERP Quality Server ................................. SUCCESS[  0.026 s]
[INFO] ERP Trade Server ................................... SUCCESS[  4.918 s]
[INFO] ERP Planning Server ................................ SUCCESS[  2.876 s]
[INFO] ERP Trade Batch .................................... SUCCESS[  0.957 s]
[INFO] ERP System Client .................................. SUCCESS[  2.665 s]
[INFO] ERP Trade Client ................................... SUCCESS[ 10.940 s]
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
```

The Wercstat-ERP version number is automatically added to the JAR-file name, for example `erp-trade-client-1.6.7.jar`.

Deploy the JAR artifact

Normally every server has a fixed `application.properties` file with specific settings, including the database connection. Deploying the application is as easy as copying the compiled artifact (the `.jar` file) and starting it from Java:

```
java -jar erp-trade-client-1.6.7.jar & ①
```

① the `&` parameters starts the application in the background

The following banner is displayed on start-up:

```
__          __                _        _     ______ _____  _____
\ \        / /               | |      | |   |  ____|  __ \|  __ \
 \ \  /\  / /__ _ __ ___ ___| |_ __ _| |_  | |__  | |__) | |__) |
  \ \/  \/ / _ \ '__/ __/ __| __/ _` | __| |  __| |  _  /|  ___/
   \  /\  /  __/ | | (__\__ \ || (_| | |_  | |____| | \ \| |
    \/  \/ \___|_|  \___|___/\__\__,_|\__| |______|_|  \_\_|
```

Monitoring

The application is monitored in three ways:

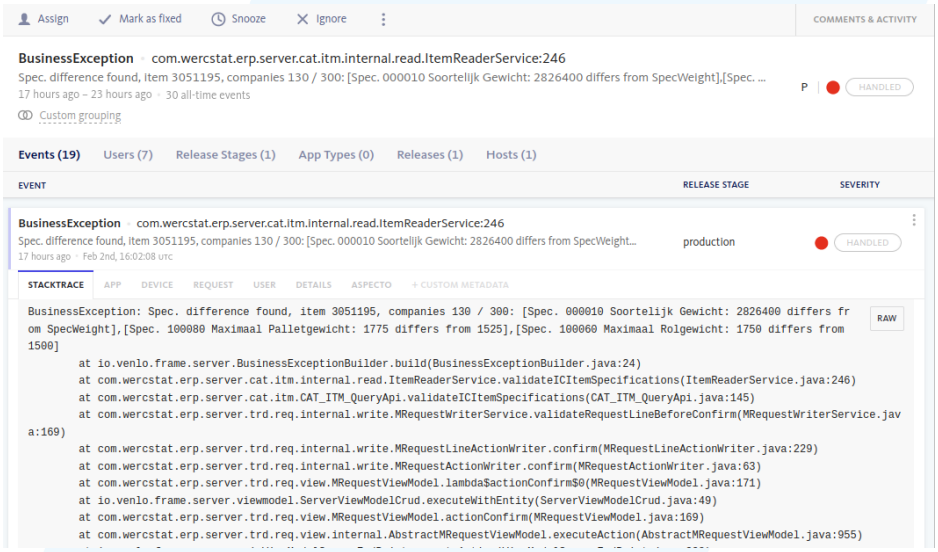
- Server-logging (`Log4J`) for normal logging and exception stack traces
- Health monitoring and metrics gathering (`Spring Boot Actuator`)
- Cloud exception monitoring (`bugSnag`)
- Custom monitoring

Server-logging and health monitoring are build-in features of `Spring Boot`.

Cloud Monitoring

`Wercstat` supports cloud monitoring, in this case `BugSnag` (https://www.bugsnag.com/), but any service can be integrated.

All exceptions in `Wercstat-ERP` are sent to the cloud with information about the server, the user and a complete `Java` stack trace.

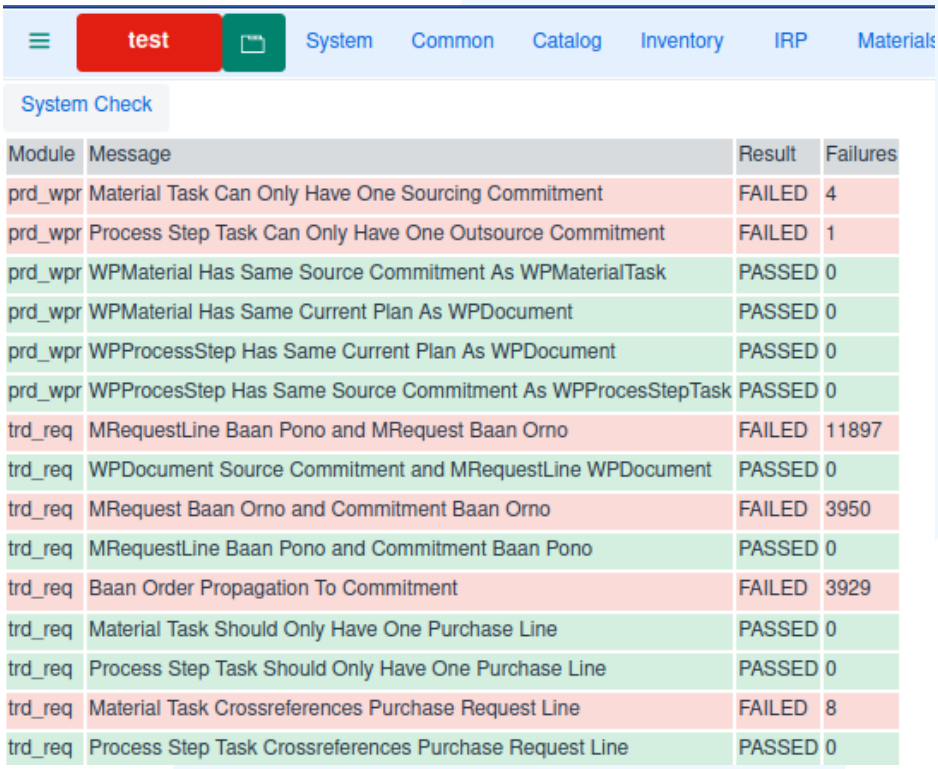


The overall occurrence of errors over time is monitored:

Support staff can be informed of errors by email based on specific business-rules. For example, the type of exception, the frequency of the exception or the server where the exception occurred.

Custom Monitoring

Custom monitoring is additional option during testing of production. For `Wercstat-ERP`, a list of "sanity checks" run on a fixed schedule and failures are automatically mailed to support staff.



Module	Message	Result	Failures
prd_wpr	Material Task Can Only Have One Sourcing Commitment	FAILED	4
prd_wpr	Process Step Task Can Only Have One Outsource Commitment	FAILED	1
prd_wpr	WPMaterial Has Same Source Commitment As WPMaterialTask	PASSED	0
prd_wpr	WPMaterial Has Same Current Plan As WPDocument	PASSED	0
prd_wpr	WPProcessStep Has Same Current Plan As WPDocument	PASSED	0
prd_wpr	WPProcesStep Has Same Source Commitment As WPProcesStepTask	PASSED	0
trd_req	MRequestLine Baan Pono and MRequest Baan Orno	FAILED	11897
trd_req	WPDocument Source Commitment and MRequestLine WPDocument	PASSED	0
trd_req	MRequest Baan Orno and Commitment Baan Orno	FAILED	3950
trd_req	MRequestLine Baan Pono and Commitment Baan Pono	PASSED	0
trd_req	Baan Order Propagation To Commitment	FAILED	3929
trd_req	Material Task Should Only Have One Purchase Line	PASSED	0
trd_req	Process Step Task Should Only Have One Purchase Line	PASSED	0
trd_req	Material Task Crossreferences Purchase Request Line	FAILED	8
trd_req	Process Step Task Crossreferences Purchase Request Line	PASSED	0

Integration Test

With almost weekly deployments to operational, the `Wercstat-ERP` application has hundreds of integration tests to ensure the stability of existing functionality.

These test rely on an in-memory database that is created at the start of every test. To assist in the creation of master test-data, the `DSL` can create an import-writer class for entities.

These classes have setters and constructors with primitive types in stead of value-types and entities.

```
@Service
public class TestDataImport_com_log implements DatabaseInitService {

    @Autowired private COM_LOG_ImportWriter com_log_importWriter;

    @Override
    public void populate() {

        // All Modes
        com_log_importWriter.addTermsOfDelivery(
            TERMS_OF_DELIVERY_EXW,
            "Ex Works",
            PLACE_OF_DELIVERY)
        .user().setExWorks(ExWorks.TRUE);

        com_log_importWriter.addTermsOfDelivery(
            TERMS_OF_DELIVERY_FCA,
            "Free Carrier",
            PLACE_OF_DELIVERY);

        com_log_importWriter.addTermsOfDelivery(
            TERMS_OF_DELIVERY_CPT,
            "Carriage Paid To",
            PLACE_OF_DESTINATION);
        ...

        // Sea
        com_log_importWriter.addTermsOfDelivery(
            TERMS_OF_DELIVERY_CFR,
            "Cost and Freight",
            PORT_OF_DESTINATION);

        com_log_importWriter.addTermsOfDelivery(
            TERMS_OF_DELIVERY_CIF,
                "Cost, Insurance and Freight",
                PORT_OF_DESTINATION)
        .user().setTransportMode(SEA);
        ...
}
```

InforLN Interface

To integrate with InforLN ERP the DSL is extended to declare external tables.

```
external-table Baan_tdlra011 baanIV external-name "tdlra011" read custom-reader{

    sha key short koor // Order Type ① ②
    sha key int orno   // Order Number
    sha key short pono // Order line

    sha date t_date    PlanDate ③
    sha short kotr     // Transacation Type

    sha int leno        // IdNo
        string cprj 6   // Project
        string item 16  SubstrateCode
    sha string dset 11  ItemCode

        short wknr      // Week number
        short ittc      // 1=Standard Item Type
    ...
}
```

① `key` fields are part of the business key

② `sha` field are included in a checksum calculation to detect changes

③ field `t_date` is directly mapped to value-type `PlanDate`

The `DSL` can generate reader and writer classes for the external database including all required type conversion.

The `DSL` can be extended to support other legacy systems through database- or web-interfaces.

Use Cases

Entity

Restrict access to entity fields

Access to entity field setters can by restricted by implementing the `isReadOnly` method. This method is called before executing `setter` methods on public fields (so excluding calculated fields). If the `isReadOnly` returns `true`, the setter method will throw an exception.

For Example

```
@Entity
public class PurchaseAdvice extends AbstractPurchaseAdvice implements HasCommitment {

  ...

  @Override
  public boolean isReadOnly(final String pathName) {

    if(pathName.equals(CONFIRMED)) { ①
      return true;
    }

    if (isConfirmed()) { ②

      return false;
    }

    return super.isReadOnly(pathName); ③
  }

  ...
}
```

① Make sure the `confirmed` field can be set to `false`

② All fields (exception the `confirmed` field) are read-only if the `PurchaseAdvice` is confirmed

③ Always call the parent class (required for `entity-status` functionality)

Validate entity

Entities can be validated before they are updated to the database, by implementing the `validate` method.

For Example

```
@Entity
public class MRequest extends AbstractMRequest{
  ...
  @Override
  public void validate() {

    @Nullable final TermsOfDelivery finalTermsOfDelivery = getTermsOfDelivery();

    if (finalTermsOfDelivery != null) {

      @Nullable final TransportMode todTransportMode =
        finalTermsOfDelivery.getTransportMode();

      if (todTransportMode != null && !todTransportMode.equals(getTransportMode())) {

        throw BusinessException.entity(①
          "Transport mode {0} incompatible with terms of delivery {1} ({2})",
          request.getTransportMode(),
          finalTermsOfDelivery,
          request)
          .forField(MRequest.ENTITY_NAME, MRequest.TRANSPORT_MODE) ②
          .build();
      }
    }

    super.validate();
  }
  ...
}
```

① throw exception if the record is not valid

② add field information so the error can be displayed on the correct field in the user interface

According to the JPA specification, it is not allowed to inject services into entities. This means validation is limited to the fields and entities already available in the entity.

Set default entity values

Default values can be either set in the constructor, of by extending `setter` methods.

In the following example the `transportMode` field is set to the `terms-of-delivery` default, every time the `terms-of-delivery` value changes.

For Example

```
@Override
public void setTermsOfDelivery(@Nullable final TermsOfDelivery termsOfDelivery) {①

  super.setTermsOfDelivery(termsOfDelivery); ②

    if (termsOfDelivery != null) {

      setTransportMode(termsOfDelivery.getTransportMode()); ③

    } else {

      setTransportMode(null);
    }
}
```

① override the `setTermsOfDelivery(…)` method in the abstract class

② make sure to call the parent method (a.o. for the `readOnly` checks)

③ use setters to change other fields in the entity

Default that are set to help users during data-entry, should be part of the `view-model`, and not part of the entity as in this example.

View-model

The business logic in `view-models` is aimed to assist users with data entry.

Set default form values

A common way of helping the user is to fill fields automatically with default values.

For example

```
@ViewModelComponent
public class MRequestViewModel extends AbstractMRequestViewModel{

  private final CAT_MRK_QueryApi cat_mrk_QueryApi;
  ...
  @Override
  public void setPartner(@Nullable final Partner partner) {

    super.setPartner(partner);

    if (partner != null) {①

      setLanguage(partner.getLanguage());
      setCurrency(partner.getCurrency());
      setLineOfBusiness(partner.getLineOfBusiness());

      setMarket(cat_mrk_QueryApi.getDefaultPartnerMarket(partner));②
    }
  }
  ...
}
```

① The `view-model` represents a form on the web-page where every field is potentially empty.

② Service injection is allowed in the `view-model`

After the user selects a new partner (customer or supplier), the default language, currency, line-of-business and market are copied from the partner-entity to the `view-model`.

Add warning field

The user needs to be informed of an error in the data-entered, but just with a warning field, not with pop-up messages.

For Example

In this use case the planned delivery date has to be checked against a customer address. If it is not the preferred delivery date, a warning should be displayed.

Approach: add a form field with a red background to display the warning-text, and make sure the field is only visible if the warning is set.

Figure 4. Field without warning message

Figure 5. Field with warning message

First create a CSS class for the warning:

```
theme-set SYS_Layout{
  ...
  css-class CSS_WERCSTAT_FIELD_WARNING "real-field-warning"
  ...
}
```

Add a form field to hold the message text:

```
viewmodel MRequestViewModel custom{
    entity MRequest

    form{
        attribute Description defaultDeliveryDateWarning
    }
    ...
}
```

Add the form field to the form:

```
form MRequestFormSO
{
    viewmodel MRequestViewModel

    section s1 {
        ...
        label plannedDeliveryDate
        row {
            value plannedDeliveryDate
            field prioritySignOffWPTasks
            value defaultDeliveryDateWarning read-only ①
            css-class CSS_WERCSTAT_FIELD_WARNING ②
        }
        ...
}
```

① the warning field

② add the css-class for a red background

In the view-model code add a method to update the warning-message

```
private void updateDefaultDeliveryDateWarning() {

    setDefaultDeliveryDateWarning(MRequestUtil.getDefaulDeliveryDayWarning(
        getDeliveryAddress(),
        getPlannedDeliveryDate()));
}
```

Make sure the field is updated

```
@Override
public void afterLoadRecord() {①

  updateDefaultDeliveryDateWarning();
}

@Override
public void setDeliveryAddress(@Nullable final Address deliveryAddress) {②

  super.setDeliveryAddress(deliveryAddress);

  updateDefaultDeliveryDateWarning();
}

@Override
public void setPlannedDeliveryDate(@Nullable final PlanDate plannedDeliveryDate) {②

  super.setPlannedDeliveryDate(plannedDeliveryDate);

  updateDefaultDeliveryDateWarning();
}
```

① the form-field is not part of the entity, so it has to be recalculated every time a new record is loaded

② the moment the planned delivery date or delivery address change, the warning has to be recalculated

Finally make sure the warning is only displayed when not empty

```
@Override
public ComponentStatus getFieldStatus(final String fieldName) {

  if (MRequestViewModel.DEFAULT_DELIVERY_DATE_WARNING.equals(fieldName)) {

    if (getDefaultDeliveryDateWarning().isEmpty()) {
      return ComponentStatus.HIDDEN;
    }
    return ComponentStatus.READONLY;
  }
```

Selection Form

Requirement

User enters one or more selection field values which will filter the records of a grid.

For example, inventory selection, the user enters a company and item which will filter the

inventory and inventory-transaction grids.

Create Selection ViewModel

The `view-model` has no entity declaration, only a company and item form field.

```
viewmodel EconomicInventoryByItemViewModel custom{ ①

    form {
        relation Company company
        relation Item item
    }
}
```

① the `custom` tag moves the `view-model` to the manual source folder

Create Form

The form only holds the two selection fields, and the description fields form the company and item entities.

```
form EconomicInventoryByItemForm
{
    viewmodel EconomicInventoryByItemViewModel

    field company [description]

    field item [description]
}
```

Create Page

Next create a page with the selection Form together with the grids that need to be displayed and filtered.

```
page EconomicInventoryByItemPage economicInventoryByItemLabel custom {

    viewmodel EconomicInventoryByItemViewModel selectionViewModel
    viewmodel UnitInventoryViewModel unitInventoryViewModel
    viewmodel PlannedInventoryTransactionViewModel transactionViewModel

    bind transactionViewModel field "unit"  ①
    to unitInventoryViewModel field "unit" auto-select

    view EconomicInventoryByItemForm selectionForm selectionViewModel
    view UnitInventoryGrid unitInventoryGrid unitInventoryViewModel
    view PlannedInventoryTransactionGrid transactionGrid transactionViewModel

    segment panel1 economicInventoryByItemLabel{
        input selectionForm
        display unitInventoryGrid
        display transactionGrid
    }
}
```

① the `inventory-transaction view-model` is bound to the `inventory view-model`

HTML Info Button

Requirement

For the user to check how a workflow task was executed, an overview of all events regarding a single task is needed.

The information view can be accessed via a button in the workflow-task page, and must dislay a HTML page with status-changes, team-transfers, etc.

Add Action to ViewModel

```
labelSet COM_Labels{

    ...

    label executeDisplayTaskEventsLabel "Events" icon "INFO"

    ...
}

viewmodel WFTaskViewModel custom{
    ...
    actions{
        ...
        action executeDisplayTaskEvents executeDisplayTaskEventsLabel
    }
    ...
}
```

The new action will add the following code to the `AbstractWFTaskViewModel` class.

```
    @Label("executeDisplayTaskEventsLabel")
    @Action
    public abstract void executeDisplayTaskEvents(@NonNull Parameters parameters);

    public abstract ComponentStatus getExecuteDisplayTaskEventsStatus();
```

Your IDE will generate an error message on the concrete `WFTaskViewModel` class, prompting to implement the methods.

Create Service

First we create a service to render the HTML document. The service is called within a transaction on the server-side, so we have access to the full data-model.

```
@Service
public class WFTaskEventDisplayService {

    public void renderTaskEvents(
            final WFTask task,
            final HtmlDocumentBuilder report) {

        @Nullable final User initialAssignedToUser = task.getInitialAssignedToUser();

        report
        .beginTable()
        .setBackgroundColor(RealDocumentColor.COLOR_LIGHT_BLUE)
        .beginTableSection("Initial Settings",2) ①
        .setBackgroundColor(null)

        .addFieldRow("Team", task.getInitialAssignedToTeam().getDescription())
        .addFieldRow("Due Date", task.getInitialDueDateTime())
        .addFieldRow("Priority", task.getInitialPriority())
        .addFieldRow("Status", task.getInitialStepStatus().getDescription());

        if(initialAssignedToUser!=null) {
            report.addFieldRow("Owner", initialAssignedToUser.getName());
        }

        if(!task.getTransferEvents().isEmpty()) { ②
            @Nullable final User assignedToUser = event.getAssignedToUser();
            report
            .beginRow()
            .cell(event.getCreatedBy())
            .addCell(event.getEventDateTime())
            .addCell(event.getAssignedToTeam().getDescription())
            .addCell(assignedToUser!=null?assignedToUser.getName():null)
            .endRow();
        }

        if(!task.getStatusEvents().isEmpty()) { ③
        ...
        }

        if(!task.getPlanEvents().isEmpty()) { ④
        ...
        }
    }
}
```

① A task has defaults based on the process-definition

② Transfer-events assigns the task to other Users / Teams

③ Status-events register process-dependent status changes

④ Plan-events register changes in due-date

Implement Action

The `info` button should be visible when ever a `Task` is selected.

```
    @Override
    public ComponentStatus getExecuteDisplayTaskEventsStatus() {
        return ComponentStatus.enabledIf(isRecordSelected());
    }
```

In order to implement the HTML report we have to import the service, create a document builder and call the render method.

Add the service to the `WFTaskViewModel` class.

```
    @Inject
    @ViewModelField(ViewModelFieldType.SYSTEM)  ①
    private WFTaskEventDisplayService wfTaskEventDisplayService;
```

① Specify that the service is not part of the server `view-model` state. Otherwise `Wercstat` might try to transfer the object to the client `view-model`.

Next, implement the method and call the service.

```
    @Override
    @Action(group = WF_CLAIM_ACTION_GROUP, order = 1) ①
    public void executeDisplayTaskEvents(final Parameters parameters) {

        executeWithEntity(task->{ ②

            final HtmlDocumentBuilder report = new HtmlDocumentBuilder(); ③

            wfTaskEventDisplayService.renderTaskEvents(task, report); ④

            final String htmlPage = HtmlDocumentUtil.htmlPagesToColumns(
                    report.getPages()); ⑤

            final DisplayHtmlDesktopCommand displayCommand =
                DisplayHtmlDesktopCommand.create(
                    "<H1>Task: "+task.getDescription()+"</H1>",
                    htmlPage,
                    false); ⑥

            getRequestContext().desktop().addCommand(displayCommand); ⑦
        });
    }
```

① The Task page is updated by events, not user input, there is no default task-bar. This `ActionGroup` is added as toolbar to the form-view.

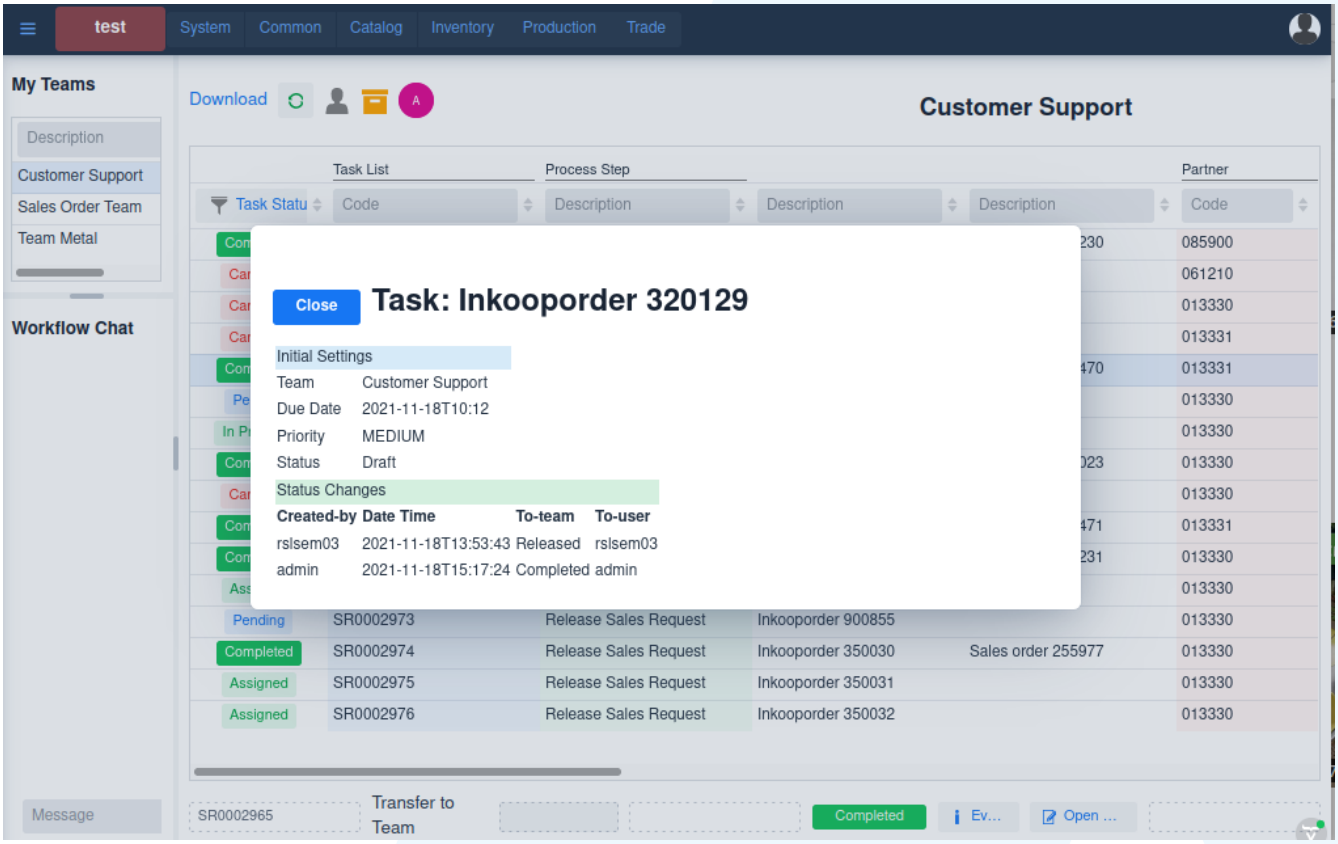
② Select the entity belonging to the current selected record in the `ViewModel`

③ Create a Html Report Builder

④ Add content to the report

⑤ Render the pages as columns in HTML

⑥ Create a client-side command to display the HTML content

⑦ Add the command to the request-context to execute it on the client-side

End Result