# BIDIS – A WORKFLOW MANAGEMENT SYSTEM FOR INLAND TERMINALS

### A. MATHEJA, C. ZIMMERMANN, M. LARNOULD, M. MISKA AND M. BERNARD

Franzius-Institute for Hydraulic, Waterways and Coastal Engineering University of Hanover Nienburger Straße 4, 30167 Hannover, Germany

## ABSTRACT

At present inland waterway transport (IWT) is mainly used to carry out transport operations in port-toport relations. As integrated part of supply chains and key mode of intermodal transport chains it is applied only in few and exceptional cases. So far, IWT does not exploit its full potential as strategic, future oriented transport mode focusing on medium and long distances. To promote the given strategic advantages in terms of loading capacity, security and safety, cost effectiveness, ecological advantages the competitiveness of IWT has to be increased against land based transport modes.

Thus, comfortable and effective workflow management and information systems are required in seaports as well as inland terminals (ITs) to ensure transfer of relevant information between all participants and faster port operation (including quality management). Especially for ship based just-in-time container transports, these systems are fundamental for IT operation.

In this context, a JAVA based workflow management and information system (*BIDIS*) for ITs, focused on container transport with extensions for general cargo, was developed. Basic modules and capabilities of the system (e.g. ship storage planning, gate application, damage handling, personnel planning and EDIFACT data transfer to seaports, ship clients and the end-user) are presented.

Incoming EDIFACT messages are handled by a special application server (IPEM) transferring messages to the internal object oriented format and converting outgoing message to file based EDIFACT file format. ITs connected by *BIDIS Port Clients* are transferring objects via IPEM - not files as necessary in older systems using common software technology.

It is shown how *BIDIS* was setup and adopted to satisfy user needs (e.g. information for skippers, internal planning and handling by port authorities and information for end user), including scalable data base concepts underlying the *BIDIS Port Client*.

The present result of the software engineering process is a modular object oriented tool with dynamic functionality. Its development and following tests in practice have shown applicability, limitations and necessary future developments. The adopted object oriented approach the starting point for future developments towards a distributed workflow management system for ITs.

Keywords: Integrated Transport and Logistical Systems, Inland Terminals, Workflow Management System

### **1. INTRODUCTION**

The quality of inland waterway transport in multi modal transport chains depends on planning and monitoring of combined door-to-door transport, management and processing of logistic tasks including pre-/end haulage and transhipment, tracking and tracing at freight level, interconnectivity and automated data transfer, reduction of handling times and quality of transport itself (fast, just-in-time, secure, cost effective). In this context, ITs play an important rule for collection and distribution of cargo, logistic services and chain management and other services (loading, storage, packing, stripping).

Besides cargo handling (loading, storing), ITs have to provide added value services to their clients in terms of tracking and tracing of freight in/outside their terminals and a better planning of their working activities and services to ensure just-in-time transport for the client.

Thus, an information network between seaports (SPs), ITs, and their clients has to be established to give (a) advanced access solutions (remote access as well as interactive web access), (b) demand or event driven logistic task management and (c) interconnectivity in terms of EDI based interface application in order to develop ITs as communication platform to provide respective services.

Also inside ITs, services and work flows have to be optimised - increasing attractiveness and effectiveness of IT operation.

This scenario motivated the development of an information and operation system for ITs, called *BIDIS* (Binnenhafeninformations- und –dispositionssystem). *BIDIS* has been implemented to combine interconnectivity management (*BIDIS IPEM Server*) with workflow management for inland terminals (*BIDIS Port Client*), Fig. 1.



Fig. 1: BIDIS Communication Structure and Module Interaction

*BIDIS* provides a link to *WABIS* (Wasserstrassenbetriebs- und Informationssystem), a waterway traffic management and operational system giving real time access to (a) vessel information (ship position, speed and fuel consumption available from vessels, navigation and engine control equipment), (b) vessel's business information (free loading capacity, time schedule, and route planning loading/unloading times, necessary stops), (c) fairway information (water levels, currents, available water depths) and (d) vessel traffic management (VTM) information (traffic restrictions, actual and future lock planning, traffic density in a regional context, traffic predictions, estimated time of arrival).

Following chapters will describe underlying concepts and functionality of main *BIDIS* applications to give an introduction and overview to system capabilities.

# 2. BIDIS IPEM SERVER APPLICATION

*BIDIS IPEM SERVER* handles communication from/to *BIDIS* with other parties (SPs, Its, ship companies, clients) getting/providing information for logistic chain management (Fig. 2). The main application consists of a modul controling information update on the server side, a control panel, an administration tool and a module converting data to/from different formats.



Fig. 2: BIDIS IPEM SERVER Structure

The main application can be started as independent server application, controlling available servers for communication, defining the interfaces for different ports and specifying the control options to have a look to data transaction activities (Fig. 3).

IPEM Kontrolle	
Datei Einstellungen Hiffe	
💹 🛱 🛸	
Server Info	Anzeige
Server-IP 255.255.255.2	55 Starte Server-Update: Wed Feb 07 20:53:14 GMT+01:00 2001
Subnet-Mask 255.255.255.2	55 Abfrage der angeschlossenen Server
FTP-Connect online	Verbindung zu DAKDSY Test aufgebaut
Schiff-Ausgang office	Es sind 7 neue Dateien vorhanden
Shiff-Eingang Office	Datei ballililili.dat wird gespeichert
BA01-Interface office	
COPRAR-Interface office	
COARI-Interface office	
PIOS-Interface office	
Panel	
Einzelverbindungen anzeigen 🔽	Meldungen
Auswertung anzeigen	Server was started: Wed Feb 07 20:52:13 GMT+01:00 2001
Verteilung anzeigen	
Ship anzeigen 🔽	
	Wed Feb 07 20:53:19 GMT+01:00 2001

Fig. 3: BIDIS IPEM SERVER Main Application

Every module is startet as a thread to be independent against the server application. Threads are messaging to the server reporting their status, updating server information and indicating errors. Server updates are generated by (a) sending a request to external servers, (b) controlling ship messages, messages from ITs, Clients, SPs, (c) converting data and (d) distribution of data.

For data transfer an FTP-Manager was implemented as platform independent application (JAVA), managing secure connection to external servers and getting/sending requests and data (passive in binary mode). Relevant data is extracted from input stream, converted and send to relevant inbox/outbox directories on the server side.

# **3. BIDIS SHIP CLIENT APPLICATION**

The *BIDIS SHIP Client* application is used to establish communication between ITs and ships. Password restricted access to this module was implemented to get up-to-date vessel information (fuel consumption, navigation and engine control equipment if available) and vessel's business information (free loading capacity, time schedule, and route planning loading/unloading times, necessary stops) for the *BIDIS PORT CLIENT*. Most important for IT operation is the cargo position on board of ships (storage plan) after leaving SPs or ITs.

Nummer	Tvp	Inhalt	Gewicht	Lage	Position	
A-2000	DryVan	leer	1	5	82	
K-1100	Dry Van	Panier	12	0	C4	
Z-1000	Dry Van	Ferticteile	9	ã	K1	
Z-1006	Dry Van	Holz	13	2		
17 4 900	Partient	Aralla ana a	4.0	r	119	
cht in der Liste						
		e d'antes tates				
	A-2000 K-1100 Z-1000 Z-1006 M 1-200 Sht in der Liste	te Nummer Typ A-2000 Dry Van K-1100 Dry Van Z-1000 Dry Van Z-1006 Dry Van V 4000 Dry Van K-1106 Dry Van K-1106 Dry Van K-1106 Dry Van	Are Nummer Typ Inhait Ar 2000 Dry Van leer K-1100 Dry Van Papier Z-1000 Dry Van Pertigteile Z-1006 Dry Van Holz V 1006 Dry Van Holz Hit in der Liste	Are Nummer Typ Inhalt Gewicht A-2000 Dry Van Ieer 1 K-1100 Dry Van Papier 12 Z-1000 Dry Van Fertigteile 9 Z-1006 Dry Van Holz 13 V 1006 Dry Van Holz 13 Holz 13 Holz 13	Are Nummer Typ Inhait Gewicht Lage A-2000 Dry Van leer 1 5 K-1100 Dry Van Papier 12 0 Z-1000 Dry Van Fertigteile 9 3 Z-1006 Dry Van Holz 13 2 Hold Dry Van Holz 13 2 Hold Dry Van Holz 13 2	Are Nummer Typ Inhait Gewicht Lage Position A-2000 Dry Van leer 1 5 82 K-1100 Dry Van Papier 12 0 C4 Z-1000 Dry Van Fertigteile 9 3 K1 Z-1006 Dry Van Holz 13 2 C-1006 Dr

Fig. 4: BIDIS SHIP CLIENT Application

Thus, skippers get relevant freight data from *BIDIS IPEM SERVER*, check this data against their actual cargo and resend the revised data to the server application (*IPEM*), which distributes the data back to destinations (ITs), clients and ship companies.

# 4. BIDIS PORT CLIENT APPLICATION

### 4.1 User Administration

To guarantee a secure and stable run time, an easy to handle user administration was added after practical testing. It enables *BIDIS* system administrators to define users (personalization), delete and modify their rights, and thus create groups with special user profiles (administration group, cran group, disponents, storage group etc.).

Users have to login to the system by password, accepting that their actions and mistakes are reported by the system.

### 4.2 Business Client Administration

Business client administration stores all relevant business data (Fig. 5), making it available for pricing and accounting and relates it with client turnover for statistics.

## SECOND EUROPEAN INLAND WATERWAY NAVIGATION CONFERENCE, BUDAPEST, JUNE.13-15, 2001.

Stanndatenverwal	lung Tarifa Ortsonschen Sirbarbeit Administration	
Kundenstammdate	ane onoangalon onnemen Ponningalon	
Erster zurück	vor Letzter neu Suchen Löschen Beenden	
Kundennummer:	3	
Kreditorennummer:	K00003	
Kd-Zugehörigkeit	3	
Name 1:	Muster KG	
Name 2:	Abteilung Fakturierung	
Name 3:	F	
Straße:	Hafenstr. 10	
Ort	Musterhausen	
Postfach:	Postfach-PLZ:	
Land / Postleitzahl:	46446	
Kontoblatt		
Rechnungsted	Zahlbar innerhalb 14 Tagen rein netto Kasse	
MindestEntgelt:	5.00 ¥	
Kunde seit	0:00:00	
USHD Nummer:		

## Fig. 5: Business Client Application

pot:					
			Referenz		
ыm			Herkunft		
t-Beladestelle:			Ent-/Beladedatum:		
pot			Referenz:		
NE			Destination:		
ernahmedatum:			Rückgabedatum:		
ankommende Sendun			ausgehende Sendun	C Sch	if
	C LKW			C LIM	¥.
	C Bahn			C Bah	n
1	Container hir	nzufügen			
Größe	Тур	inhait	Gewicht		Gefahrgut
	t-Æeladestelle: tot: iff: emahmedatum: ommende Sendun [1 Größe	t-iBetadestelle:	LiBeladestelle:	Image: Second	Image: Section of the section of t

Fig. 6: Definition of Consignments from Business Orders

#### **4.3 Generation of Consignments**

Getting an order from business clients, the logistic chain manager transfers it to the system by splitting it into different consignments for requested relations (point-point relations), indicating that this freight should be transported together (Fig. 6).

Each consignment contains cargo information, transport mode and relevant data about take over and return (date, depot, special agreements etc.). Information about single freigt units is available from the list.

#### 4.4 Loading/Unloading List

Transports<sup>1</sup> are set up by performing a loading list for a point-point a relation (Fig. 7). Therefore freight can be selected from a list generated from available consignments. After choosing a transport unit (loading capacity and storage characteristics of barges and ships are managed by templates showing detailed free loading capacity), freight can be placed on the ship by drag-drop functionality.

Lünch-/Ladelinte												
Transportnummer;	1	-					Dis	ponent:	Hohis		-	
			7	u ladendi	e Containe	e.			,			
Starthafen:	Hannover	*	1	Rooded	Nummer	Gewisht	Lânite	Datum	Sendure	Authrag	-	
Zielaster	Promothesin	-		MSK R	12-1014	13	2011	2000-11-10	1	-		
Contractor.	found to the first of the			MSK K	LZ-1015	13	2011	2000-11-10	1	1		
				MSK K	1.2-1016	13	2011	2000-11-10	1	-		
pont auswaren	-			HOK K	1.7.1019	13	201	2000-11-10				
				MRK K	1.2.1010	13	201	2000-11-10	1	-		
				OHL K	LA-2002	1	40 11	2000-11-18	2	i - 1		
				GHL H	UK-1300	13	20 ft	2000-12-01	1	2	-	
E.o.	22.0	0.0	<b>D</b> 2.0	-		- F	1.0			5	_	
p.0	htt	μu	12.0		prov.				9	p s		1
										_	_	
	UHL			_		_						
	KLA-2000		L	-								11.0
	1											
			GHL									
			HJI6100	0								22.0
			10									
					_			$\rightarrow$				
										-		
			L							-		24.0
Transfer of the												
Lage1 Lage 2												
Traditionet		8.829	_									
in opensystem			_									
Tragfahigkeit-Ladung	Is gewicht:	1471.0										
Abfahrtsdature:					Fract	vibrief		Drucken	A	brechen		OK
Ladurgsbegins												

Fig. 7: Loading List for Definition of Transports

Trim of the ship/barge can be optimised by lateral and longitudinal weight control. Loading capacity is automatically restricted by template definition after picking a ship by name from the list. As every task in *BIDIS*, creating loading/unloading lists needs authorisation, which has to be entered separately for this module, due to consequences coming up for transport management in the case of errors.

#### 4.5 Gate Application

ITs are liable for damage of freight in their area. Control of incoming/outgoing boxes becomes an important task, especially for container transport with high added value services (Fig. 8).

The *BIDIS GATE CHECK* application was developed to perform checks for different gates (truck gate, ship gate and rail gate). Implementation is flexible for porting the application to hand-helds. From a incoming/outgoing list (created for the identified gate from the freight list) the transport unit (e.g. container) can be selected and checked. If damaged, a report is send to the repair unit and the logistic transport manager responsible for the transport, checked freight belongs to.

<sup>&</sup>lt;sup>1</sup> Def.: Transport of freight (bulk or containers) with a single transport unit (barge or ship) for a pointpoint relation.

himme	Datum	Lings Gratett Inhalt
xxxx(several)	2001-02-11	20 ft 13.8
bbb123	2000-02-10	20 ft 15
Contain	erdaten	40 ft 24.0
	Nummer	bbb123
	Långe	20 ft
	GesamtBruttoGewicht	15
	Inhalt	
	D	2
EI	In Hafen	nicht_angekommen
	Datum	2000-02-10
-	Zeit	12:35
	Beschädigung	1
	Kontrolliert	Marc Miska
	Firma	ABC Logistik
	Person	Schmidt
	Schiff	MS-Mateya
	LION	123456
	Remerkunnen	-

Fig. 8: Multi Purpose Gate Check (here: Truck Gate)

#### 4.6 Internal Communication Scheme

*BIDIS PORT CLIENT* applications, running on different PCs distributed over the IT area, use the *BIDIS Client Module* sending requests to the *BIDIS Port Client Server* and getting relevant data for their specific tasks (Fig. 9).



Fig. 9: Communication of BIDIS PORT CLIENT Applications with the BIDIS Port Client Server

The *BIDIS Port Client Server* holds the established connection and responds to client requests (Fig. 10). Transfer errors (e.g. communication channel not created, locked or destroyed, application on client/server side or system shutdown) are handled by a multi layer model, responding in different steps to requesting applications and/or sending an error report to the system administrator.



Fig. 10: Communication of BIDIS PORT CLIENT Applications with the BIDIS Port Client Server

Transactions are managed by the *BIDIS Workflow Manager*, which organize the incoming requests/jobs and executes them. Execution of the job FIFO list is done by periodic triggering and transaction using a two phase lock protocol.

Access to underlying data is restricted by a security concept based on the *BIDIS* user administration. Running *BIDIS PORT CLIENT* applications transfer user names while requesting data and/or functions from the *BIDIS Server Module*. Internal relations between user groups (and associated rights) and data structures manage the final data access.

### 5. CONCLUDING REMARKS AND FUTURE DEVELOPMENT

IWT has to play a key role for transport on medium and long distances in intermodal transport chain operations. Thus, information and workflow management in ITs and data connectivity between SPs, ITs, logistic service providers and ship companies will be an essential part to improve competitiveness of IWT against land based transport modes. The development of *BIDIS* gave a corridor for ITs to play this part, especially as logistic service providers managing reliable door-to-door transport chains.

Future adaptions and developments of *BIDIS*, such as new data formats and interfaces for external servers (*Logistic Data Platform*), automatisation of IT tasks and optimisation of local storage capacity and automated information of receivers, are easy to gain, due to modularisation and object oriented design of the system.

One of the main future tasks will be the interaction of *BIDIS* – *WABIS* to provide forecasted ship positions to business clients, ship companies and ITs for optimisation of their internal workflows (facility and personnel planning). Thus, a enhanced simulation model based on cellular automates will be implemented in *WABIS*, forecasting waterway traffic for ETA calculation.

#### 6. ACKNOWLEDGEMENTS

This project was supported by the Bundesministerium für Bildung, Wissenschaft Forschung und Technologie (bmb+f), Deutschland and executed in cooperation with DAKOSY AG, Deutsche Binnenreederei AG, Städtische Häfen Hannover and Hafenbetriebsgesellschaft Braunschweig mbH.