



## **APPROACHES TO THE SOLUTION OF BELT TRANSPORTATION INFORMATION SYSTEM**

### **PRISTUPI REŠENJU ZA INFORMACIONI SISTEM TRANSPORTA SA TRAKOM**

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**Abstract:** *The paper is focusing on approaches to the solution of belt transportation information system. Existing solutions and available software are not sufficient in this way, therefore new approach and required aspects of information system are presented. The concept based on database system is described. Formulated approaches are integrated in information system ISPD which is being developed at Department of industrial logistics and transportation, Technical university of Košice.*

**Key words:** *Information system, belt conveyor.*

**Apstrakt:** *Ovaj rad se fokusira na pristupe rešenju za informacioni sistem transporta sa trakom. Postojeća rešenja i raspoloživi softver nisu dovoljni, pa su stoga prikazani nov pristup i traženi aspekti informacionog sistema. Opisan je koncept zasnovan na sistemu baze podataka. Formulirani pristupi su integrisani u informacioni sistem ISPD koji je razvijen na Katedri za industrijsku logistiku i transport, Tehnički Univerzitet Košice.*

**Ključne reči:** *informacioni sistem, transporter sa trakom.*

## **1 INTRODUCTION**

The paper is focusing on approaches to the solution of belt transportation information system. Existing solutions and available software are not sufficient in this way, therefore new approach and required aspects of information system are presented. The concept based on database system is described. Formulated approaches are integrated in information system ISPD which is being developed at Department of industrial logistics and transportation, Technical university of Košice.

## **1 UVOD**

Jedna od bitnih delatnosti u pogledu transportera sa trakom je monitoring i evidentiranje događaja vezanih za njegov rad. Bez ovakvog evidentiranja teško je planirati operacije održavanja, procenjivati učinak transportera, poboljšati rad ili sniziti troškove. Odsustvo odgovarajućih alata je naročito primetno kada je potreban brz proces i procena evidentiranih podataka. Ovaj rad opisuje pristupe rešenju za informacioni sistem transporta sa trakom u gore navedene svrhe.

## 2 EXISTING SOLUTIONS AND PRODUCTS

Nowadays, there is wide variety of specialized software products for belt conveyors available on the market. These applications enable to design and compute the required parameters of the belt conveyors and their parts. Computations of tensile forces of the belt, its load capacity, required tension of the belt, belt speed, slope and other values for belt conveyor design for specific conditions can be carried out easily.

The most of these applications provide functions to test designed construction of the conveyor and its subsystems. In case of entering wrong values or values that do not fall in allowed limits, the application notifies the user that the solution is not feasible. Some of the applications can suggest alternative solution or solution that is in allowed limits or it is more suitable for given conditions. The example of software products include Pro-Belt, BeltStat, Beltcomp, Sidewinder, Belt Analyst 2007 and Helix Delta-T.

Alternative approaches of recording the operation and events related to belt conveyors include following:

- manual recording of important information and events in written form on paper or card,
- recording in electronic form in spreadsheet application or text editor.

## 3 DISADVANTAGES OF EXISTING SOLUTIONS

Unfortunately, any of the mentioned software applications do not contain modules for monitoring and recording the operation or events of the designed belt conveyor or its parts used in real working environment. The alternative approaches of recording the conveyor operation and events have these disadvantages:

- different ways of recording: the main disadvantage of the alternative methods is that the same event can be recorded in different way. Even in the case of recording by the same person, the events occurring in various times will be recorded differently with high probability.

## 2 POSTOJEĆA REŠENJA I PROIZVODI

Danas se na tržištu može naći širok spektar specijalizovanih softverskih proizvoda za transportere sa trakom. Te aplikacije omogućavaju da se projektuju i izračunaju potrebni parametri transportera sa trakom i njihovih delova. Mogu se lako izvršiti izračunavanja sila naprezanja u traci, njen kapacitet opterećenja, tražena napetost trake, brzina trake, nagib i druge vrednosti potrebne za izradu transportera sa trakom za rad u posebnim uslovima.

Većina ovih aplikacija pružaju funkcije testiranja projektovane konstrukcije transportera i njegovih pod-sistema. U slučaju unosa pogrešnih vrednosti ili vrednosti koje ne spadaju dozvoljene granice, aplikacija obavestava korisnika da rešenje nije izvodljivo. Neke od aplikacija mogu predložiti alternativno rešenje ili rešenje koje je u dozvoljenim granicama ili više odgovara datim uslovima. Primer softverskih proizvoda uključuje Pro-Belt, BeltStat, Beltcomp, Sidewinder, Belt Analyst 2007 i Helix Delta-T.

Alternativni pristupi evidentiranja rada i događaja koji se odnose na transportere sa trakom uključuju sledeće:

- Ručno evidentiranje važnih informacija i događaja u pisanoj formi na papiru ili kartici,
- Evidentiranje u elektronskoj formi u tabelarnoj aplikaciji ili tekstualnom programu.

## 3 NEDOSTACI POSTOJEĆIH REŠENJA

Na žalost, nijedan od navedenih softvera ne sadrži module za monitoring i evidentiranje rada ili događaja određenog transportera sa trakom ili njegovih delova korišćenih u realnoj radnoj sredini. Alternativni pristupi evidentiranja rada i događaja transportera imaju sledeće nedostatke:

- Različiti načini evidentiranja: glavni nedostatak alternativnih metoda je to što se isti događaj može evidentirati na različite načine. Čak i u slučaju da ih evidentira ista osoba, događaji koji nastaju u različito vreme biće veoma verovatno različito evidentirani.

- Data and record backup: in the case of documents in written form on paper document it is necessary to prevent loss, damage or manipulation with the record. Documents are backed up by making a copy (by manual copy or scanning) of original documents, which is both time consuming and unpractical. The copies of electronic documents are somewhat easier to make but even them can be placed in different locations of the file system and in different forms or name according to the current user.
- Data access: paper documents need to be manually handled and that leads to damage or loss of the documents. On the other hand, working with electronic documents can lead to duplicity of files and the problem when users use different versions of the files if synchronization is missing. The following synchronization is difficult to carry out.
- Connection to other information systems: it is impossible with paper documents and limited with electronic documents due to their various formats.
- Sigurnosna (rezervna) kopija podataka i evidencije: kod dokumenata u pisanoj formi na papiru, potrebno je sprečiti gubitak, oštećenje ili (loše) rukovanje evidencijom. Dokumenta se mogu zaštititi pravljjenjem kopije (kopiranjem ili skeniranjem) originalnih dokumenata, što je i nepraktično i oduzima vreme. Kopije elektronskih dokumenata je donekle lakše izraditi ali čak i one mogu biti stavljene na različita mesta sistema datoteka i biti u različitom formatu i različitim imena, zavisno od trenutnog korisnika.
- Pristup podacima: papirna dokumenta često idu iz ruke u ruku i to vodi ka oštećenju ili gubitku dokumenata. Sa druge strane, rad sa elektronskim dokumentima može dovesti do dupliranja datoteka i problema kada korisnici upotrebljavaju različite verzije datoteka ukoliko nema sinhronizacije. Teško je slediti postupak sinhronizacije.
- Veza sa drugim informacionim sistemima: nemoguće je ostvariti sa papirnim dokumentima a ograničena je sa elektronskim dokumentima zbog raznovrsnosti njihovih formata.

#### 4 INFORMATION SYSTEM REQUIREMENTS

Required properties of the information system for belt conveyor transport are determined by main functions of the information system. The main functions are:

- 1) recording, overview and export of the activities related to belt conveyor operation as well as its parts:
  - a) main parts,
  - b) complementary parts.
- 2) recording, overview and export of the events related to belt conveyor operation as well as its parts.

Information system created for this purpose should have functions for input, sorting and processing data inserted in the system by users. The output of information system should have suitable format which enables the user to access and evaluate information about condition and operation of the belt conveyor and its parts. Events which could affect the operation or cause damage to the conveyor should be prompted out to notify the user.

#### 4 ZAHTEVI INFORMACIONOG SISTEMA

Zahtevane osobine informacionog sistema za transport putem transportera sa trakom određene su glavnim funkcijama informacionog sistema. Glavne funkcije su:

- 1) evidentiranje, pregled i izvoz događaja vezanih za rad transportera sa trakom kao i njegovih delova:
  - a) glavnih delova,
  - b) dopunskih delova.
- 2) evidentiranje, pregled i izvoz događaja vezanih za rad transportera sa trakom kao i njegovih delova.

Informacioni sistem izrađen za ove svrhe bi trebalo da ima funkcije za unos, razvrstavanje i obradu podataka koje korisnici unose u sistem. Izlazni podaci informacionog sistema bi trebalo da imaju odgovarajući format koji omogućava korisnicima da pristupe i procene informacije o stanju i radu transportera sa trakom i njegovih delova. Događaji koji bi mogli da utiču na rad ili prouzrokuju oštećenje na transporteru trebalo bi da se odmah pojave kako bi upozorili korisnika.

Information system should enable the user to record and plan regular activities as revisions, controls and change of parts for maintaining safety and adequate performance. Hardware requirements for the information system should not be high along with system's user friendly interface.

Informacioni sistem bi trebalo da omogući korisniku da evidentira i planira redovne aktivnosti kao što je revizija, kontrola i zamena delova radi održavanja bezbednosti i adekvatnog učinka. Hardverski zahtevi kod informacionog sistema ne treba da budu visoki a interfejs sistema prilagođen korisniku.

## 5 MAIN ASPECTS OF SOLUTION

The solution is based on database system which enables easy connection to other applications and various forms of exporting data. Following, exported data can be imported in selected software if this function is supported.

Database approach enables to define list of values in the database that normalize the form and input of data for the same events or activities. Examples include records of transported material quantity by the belt conveyor, record of conveyor breakdown or record of other activities on the belt conveyor.

Definition of such unified rules helps to process, filter, search data and enables to make output reports because the data have unified form and structure.

The concept of the database system is based on client-server architecture, where the client is any internet browser. The use of the internet browser enables easy access and work with the system. There is no need to install additional applications on client machines since a browser is a standard part of most operating systems for computers. This way the additional costs are minimized.

The functionality of the information system is extended of following activities:

- creation of lists of values: lists contain defined uniform names and abbreviations. This ensures the unified form for every record added by the user and enables to process, filter, search and export data. Lists are defined for following items:
- type of conveyor - contains basic types of conveyors and their description,
- names of the main parts of the conveyor,
- names of complementary parts,

## 5 GLAVNI ASPEKTI REŠENJA

Rešenje je zasnovano na sistemu baze podataka koji omogućava lako povezivanje sa drugim aplikacijama i raznim oblicima izvoza podataka. Zatim, izvezeni podaci se mogu uvesti u odabrani softver ako je podržana ova funkcija.

Pristup zasnovan na bazi podataka omogućava da se definiše spisak vrednosti u bazi podataka koje normalizuju oblik i unos podataka za iste događaje ili aktivnosti. Primeri uključuju zapise o količini transportovanog materijala po transporteru sa trakom, zapis o kvaru transportera ili druge aktivnosti na transporteru sa trakom.

Definisanje tako objedinjenih pravila pomaže u obradi, filtriranju i pretrazi podataka i omogućava da se izrade izlazni izveštaji jer podaci imaju objedinjeni oblik i strukturu.

Koncept sistema baze podataka je zasnovan na arhitekturi klijentskog servera, gde je klijent bilo koji internet pretraživač. Korišćenje internet pretraživača omogućava lakši pristup i rad sa sistemom. Nema potrebe za instaliranjem dodatnih aplikacija na klijentskim mašinama jer je pretraživač standardni deo većine operativnih sistema za računare. Na ovaj način su dodatni troškovi smanjeni na najmanju meru.

Funkcionalnost informacionog sistema je proširena na sledeće aktivnosti:

- Izrada spiska vrednosti: spiskovi sadrže definisana ujednačena imena i skraćenice. To omogućava jedan oblik za svaki zapis koji doda korisnik i omogućava obradu, filtraciju, pretragu i izvoz podataka. Spiskovi se određuju za sledeće stavke:
- Vrsta transportera – sadrži osnovne vrste transportera i njegov opis,
- Imena glavnih delova transportera,
- Imena dopunskih delova,

- events related to conveyor operation, i.e. maintenance, breakdown, change etc.,
- properties, for example quantity of transported material, lubrication, energy consumption, etc.
- parameters related to values (properties) recorded, for example units of quantity or energy consumption,
- commodities, list of commodities is used when the new event is created, it can be used with event of changing part, etc.
- manipulation with lists, overview, adding and deleting items,
- adding the conveyors, its main and complementary parts,
- adding, viewing and deleting of record of created belt conveyor.
- Događaji vezani za rad transportera, t.j. održavanje, kvar, zamena itd.
- Svojstva, na primer količina transportovanog materijala, podmazivanje, potrošnja energije, itd.
- Parametri vezani za evidentirane vrednosti (svojstva), na primer jedinice količine ili potrošnje energije,
- Roba (proizvodi), spisak proizvoda koji se koriste kada nastane novi događaj, može se koristiti sa događajima zamene delova, itd.
- Rukovanje spiskovima, pregled, dodavanje i brisanje stavki,
- Dodavanje transportera, njegovih glavnih i dopunskih delova,
- Dodavanje, pregledanje i brisanje zapisa o transporteru sa trakom.

The database is created using a relation database server (MySQL for example). The database contains tables of lists and tables with data of conveyor or its parts (Figure 1). The data in database contain:

Baza podataka se kreira pomoću servera za relaciju sa bazom podataka (na primer MySQL). Baza podataka sadrži tabele sa spiskovima i tabele sa podacima o transporteru ili njegovim delovima (slika 1). Podaci u bazi sadrže:

- data in lists, that are necessary for adding the records related to the conveyors,
- data about conveyor (record, event,...),
- data about main and complementary parts of the conveyor.
- podatke u spiskovima koji su neophodni za dodavanje zapisa vezanih za transportere,
- podatke o transporteru (zapis, događaj...),
- podatke o glavnim i dopunskim delovima transportera.

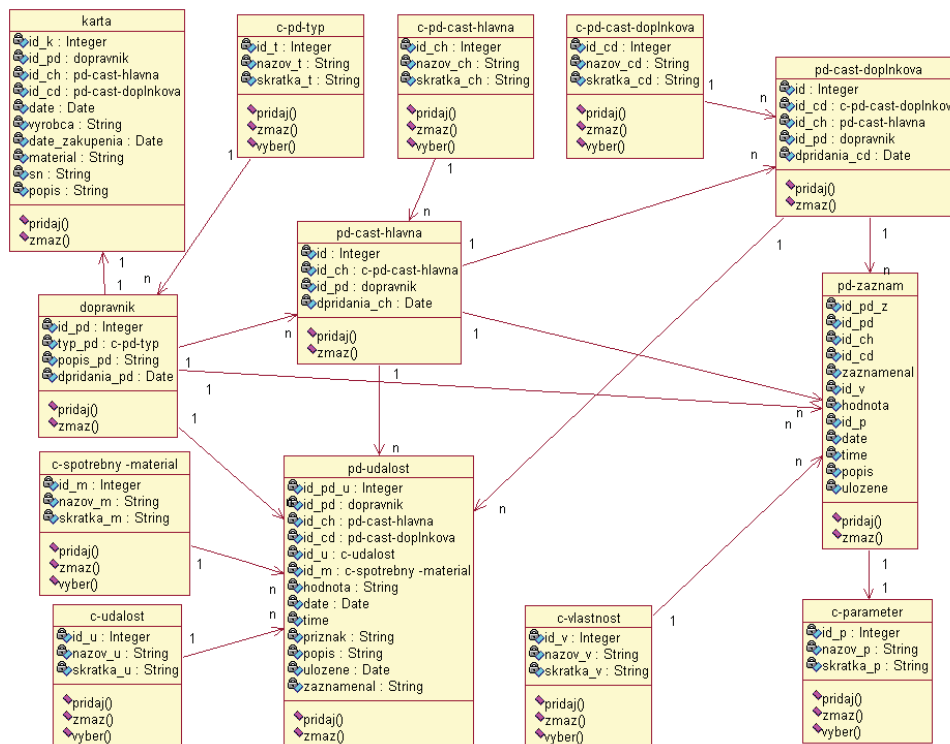


Figure 1 Relations in database  
slika1 Relacije u bazi podataka

During the creation of information system the focus was set on easy handling and adding new records into the application. The system was created in such way, that is possible to add new functions and ensure connectivity with other programs. New required features can be proposed by the users and the data of information system can be used to optimize the conveyor's operation.

These formulated approaches to the solution of belt transportation information system were integrated in information system ISPD which is developed at Department of industrial logistics and transportation, Technical university of Košice.

## 5 CONCLUSION

Approaches to the solution and required main aspects of belt transportation information system suitable for recording events related to the belt conveyor operation are presented in this paper. Existing solutions and available software is not sufficient in this way, therefore new approach is proposed. The solution is based on database system with client-server architecture concept. The created information system ISPD can be used for conveyor operation monitoring and evidence with unified records suitable for following optimization and evaluation. Since the solution is created in such way, that is possible to add new functions, new features requested by user are expected to be added in the future.

Tokom kreiranja informacionog sistema fokus je bio na lakom rukovanju i dodavanju novih zapisa u aplikaciju. Sistem je izrađen na takav način da je moguće dodati nove funkcije i omogućiti povezanost sa drugim programima. Korisnici mogu predložiti nove opcije a podaci iz informacionog sistema se mogu koristiti radi optimizacije rada transportera.

Ovi navedeni pristupi rešenju informacionog sistema za transport putem traka bili su integrisani u informacioni sistem ISPD koji je razvijen na Katedri za industrijsku logistiku i transport, Tehnički Univerzitet, Košice.

## 5 ZAKLJUČAK

U ovom radu prikazani su pristupi rešenju i traženi glavni aspekti informacionog sistema transporta pomoću traka pogodni za evidentiranje događaja vezanih za rad transportera sa trakom. Postojeća rešenja i raspoloživi softver nisu dovoljni, pa je stoga predložen novi pristup. Rešenje je zasnovano na sistemu baze podataka sa arhitekturnim konceptom klijent-server. Stvoreni informacioni sistem ISPD se može koristiti za monitoring i evidentiranje rada, uz ujedinjene zapise koji su pogodni za naknadnu optimizaciju i procenu. Pošto je rešenje izrađeno na ovaj način, moguće je dodati nove funkcije, nove opcije za koje se očekuje da će korisnik zahtevati da se dodaju u budućnosti.

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