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Local and Nationwide Information Systems Automate Mail Processing[1]

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1   Introduction

The written letter is still playing an important part in our daily communication. Thus more than 17 billion letters are accepted per year in the 22 000 German post offices and mail processing centres which must be sorted to their delivery offices. This means that close to 60 million letters are to be handled per day by the Deutsche Bundespost (DBP). The lettermail volume will continue to increase, despite of modern telecommunication media such as facsimile machines (FAX) or electronic mail. Private vendors keep pushing on the market and entice competition. This forces the postal administration to enhance and accelerate its lettermail service from a quality and cost viewpoint. In particular this is effected by the use of automation technology in the lettermail processing centres similar to that used in industrial production. Up to now sequential machines were predominantly utilised for the three main processing stages preprocessing, encoding, and sorting *(see Fig. 1)*. Today, however, customised, integrated overall systems are preferred for the automation of the mail flow within and outside of the post offices. Process control systems specific to post office use for collecting and processing the multitude of data generated are gaining more and more importance.

Thus the *AEG Electrocom corporation* in Konstanz, Germany, are providing now not only individual sorting, coding, and distributing machines as isolated problem solutions, but they have also developed solutions for overall networking. Comparable to industry's CIM (Computer Integrated Manufacturing) technologies, they have created the CIPS (Computer Integrated Postal Service) model aimed at the postal services. Similar to industrial control technology hierarchically structured organisational units were formed each having various tasks to perform. The lowest level contains the processing equipment. Letter sorting, parcel, small parcel and bundle sorting systems and conveyor and distribution systems automated with stored programme control systems perform the different mail sorting steps (preprocessing, encoding, sortation).

Networking these systems allows the consolidation to higher level monitoring and control functions. Depending on the performance and service required this task is divided further: *cell, plant, and corporation control level.*

In this model the Cell Controller controls a certain region (cell) within the processing centre (plant), while the Plant Controller is responsible for an entire processing centre (plant), and the Corporate Controller handles the centralised control of several such plants. Practice has shown, however, that the boundaries within the individual automation levels are fluid. The CIPS model is still very well capable of handling control functions and defining and systematically setting up a host of new applications. The company supports the postal administration's efforts to increase service productivity and quality.

2   Control and Monitoring Within the Processing Centre

AEG's letter sorting, parcel sorting, and small parcel and bundles sorting systems which are used all over the world, in themselves already offer an extensive range of equipment-internal control and monitoring functions. A new feature is the possibility to concentrate handling of all processing data centrally in an autonomous cell controller. This system utilises standard hardware and software components as a base for software function modules which may be linked and supplemented as needed *(see Fig. 2)*. This modularity permits to generate in a
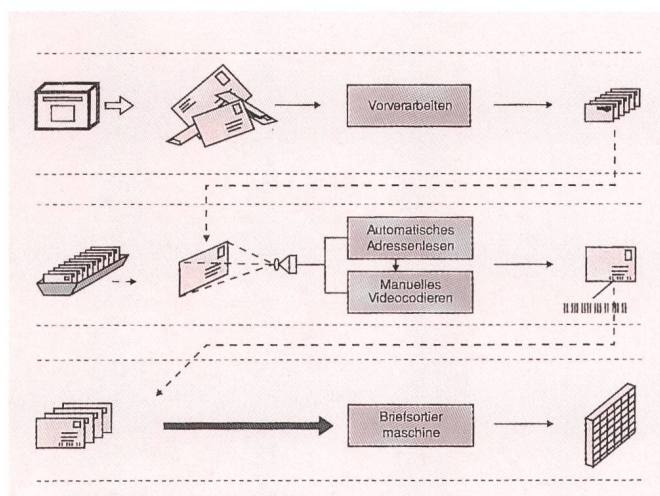

Fig. 1   Work processes in mail processing centres
Vorverarbeiten — Preprocessing
Automatisches Adresslesen — Automatic adress scanning
Manuelles Videocodieren — Manual video coding
Briefsortiermaschine — Letter sorting equipment
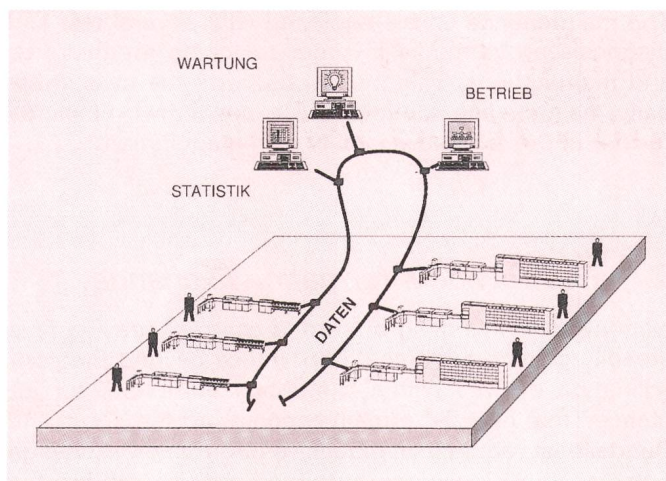
Fig. 2 Tomorrow's letter sorting
Wartung — Maintenance   Statistik — Statistics
Betrieb — Operation   Daten — Data

Fig. 3 Central control room

simple way customised solutions in a sort of building block method.

Europe's presently largest and most advanced sorting centre, the Sihlpost sorting centre in Zurich, Switzerland, already uses such a control and monitoring system. The operational status of all its letter sorting systems is centrally indicated in a central control room *(see Fig. 3)*. The process visualisation presents all letter sorting machines as an overall overview or as individual systems with their separate components. The current read rate, the sort programme selected, particular statistics, and graphical malfunction indications are some of the system features which are visualised in their actual state and which facilitate the work process. Integrated control functions also allow the central control of conveyors between the various letter sorting systems.

Another example is the Beijing processing centre in China. Large display boards show not only the functional status of AEG letter sorting systems, but also the respective data of machines from other suppliers (such as bundle sorters). AEG control and monitoring systems are also successfully used for mail processing systems in Austria, Canada, Denmark, New Zealand, and Sweden.

3 Central Generation of Statistics

A core functional module of the control system for postal automation is the central statistics generator. A computer centrally collects and files the data from several networked systems. They contain a variety of statistical functions such as operational, technical, maintenance, and malfunction statistics. Equipment data are either logged automatically (for instance shift or daily statistics) or polled manually via a menu. The user can determine the type of statistics, period covered, and cumulation for long-term statistics. The user can route the output of the statistics logs either to a monitor, printer, or data file as alphanumeric presentation, bargraph, or pie chart. The central statistics management improves man-machine resource planning and helps improving the postal administration's productivity.
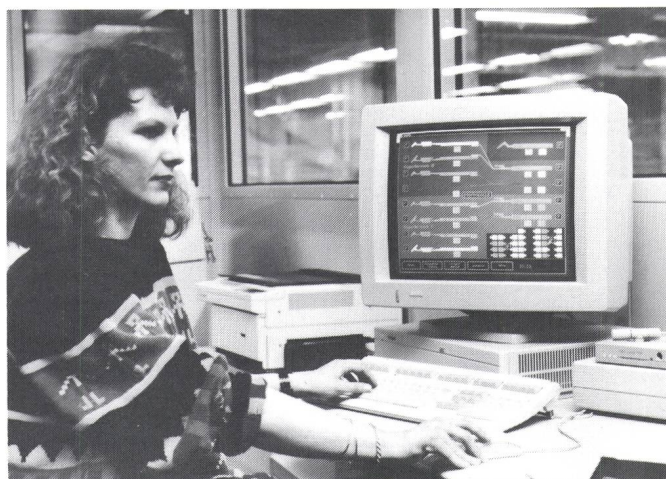
4 Visualisation and Control

Flexible mail flow in the processing centres and decentralised task handling require appropriately adapted visualisation and operator control units *(see Fig. 4)*. For the operator, a screen-supported monitoring and control system is an important window to the process and the plant. Such a control and monitoring system provides a comfortable man-machine interface that handles essentially two jobs: first, for monitoring, the equipment connected is shown very clearly and descriptively on a high-resolution color screen, and secondly, the control functions allow the operator to intervene actively in the processes. As far as sorting machines are concerned examples would be the selection of the operating mode and sort plan, control of conveyors, as well as starting and stopping the plant.

For letter sorters, parcel sorters, and small parcel and bundle sorting machines symbols for the various machines are presented on the monitor screen. In addition the read rate, operating mode, and the sort programme selected are shown. The dialog with the system is very simple. The control surface is state-of-the-art as used in today's window technique. The diverse functions are activated by clicking on a symbol or pressing a function
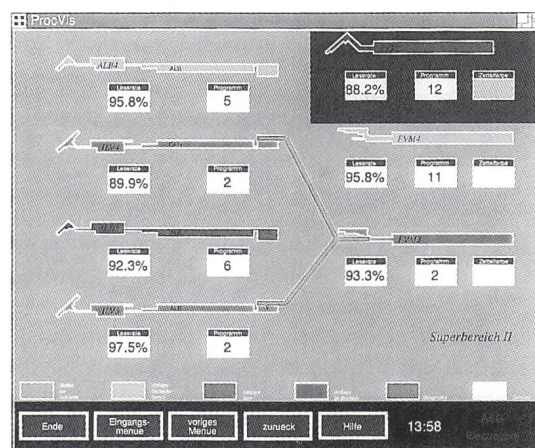

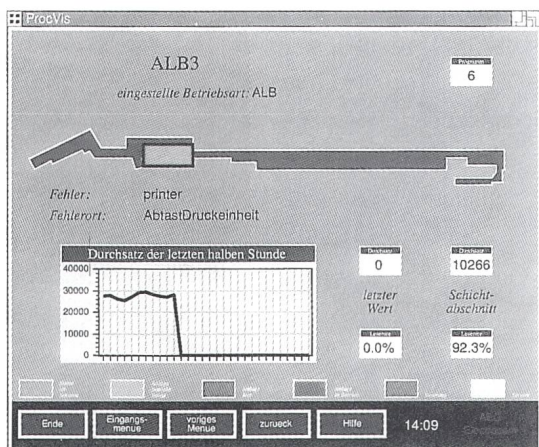Fig. 4 Visualisation and control window

Fig. 5 Representation of alarm states

key, or via clear menues. Transition from the overview level to the machine or system component levels, which are then presented on the monitor together with their status data, is effected by clicking on separate symbols.

Particular attention is paid to an optimised man-machine interface. Close co-operation with the *Daimler Benz* Research Institute resulted in the ergonomical design of the monitor screens. Experiences made in the industry in diverse areas of efforts are analysed and the results transferred to visualisation systems for postal automation.

5 Presentation of the Alarms

Of particular significance is the presentation of alarm states *(see Fig. 5)*. During the course of mail processing various malfunctions can occur that must be brought to the attention of the operating staff. Such exceptional conditions are indicated in distinctive alarm or event windows on the monitor screen. The location of the malfunction and pertinent explanations advising possible remedial action to be taken facilitate swift malfunction removal. This assists in substantially reducing downtimes. The alarms are classified in three categories: *Information* (on changes within the systems, such as status messages), *Minor Alarm* (caused by malfunctions not really affecting operations, such as malfunctions the systems can automatically remedy, or prompts to replenish paper in one of the printers), and *Major Alarm* (caused by malfunctions directly affecting operations, such as jams in one of the subsystems).

The alarm windows always have top priority and can thus not be covered by any other windows.

6 Configurations and Testing

The system management functions allow the transfer of data to and from the machines connected. In this way, for instance, new directories, postcode and destination name lists, and also software versions can be loaded and managed from a central point. Also available are editors for the generation and maintenance of directories, sort plans, and many other lists. These aids substantially improve production planning in the mail processing centres concerned.

The maintenance unit is equipped with several test and diagnosis programmes in order to locate irregularities and malfunctions. This mainly supports the user in his daily maintenance routine. These preventive measures further improve the availability of the equipment.

7 Nationwide Information Exchange

Nationwide networking of sorting centres *(see Fig. 6)* is steadily gaining additional importance beyond the consolidation of data within a sorting centre. So, for instance, the new lettermail concept of the Deutsche Bundespost requires an extensive information exchange between the 83 planned lettermail centres. Within the scope of a pilot project presently eight selected mail processing centres are linked to the General Directorate of the Postal Service (GDP) in Darmstadt, Germany, via the public Datex-P wide area network. Upon its implementation directories, sort plans, and new software versions can be managed at a central agency for the letter sorting plants connected, with a central computer in the General Directorate supervising the transmission, installation and release processes; it will also archive all current nationwide plant configurations. At the end of each month the operational data of all plants are automatically transmitted to the General Directorate permitting the generation of operational statistics. Hence all important data are always available completely and in due time. Another feature is that the General Directorate's staff has continuous access to the operational statistics of all plants. The central and immediate evaluation of traffic volumes (production data) provides the base for further optimising the utilisation of resources in the respective processing plants, since the mail volume on the way to them will already be known prior to the beginning of a shift or tour of duty.

The network also furnishes a *Remote Maintenance service* by the vendor's maintenance technicians. Maintenance and malfunction removal can be performed di-
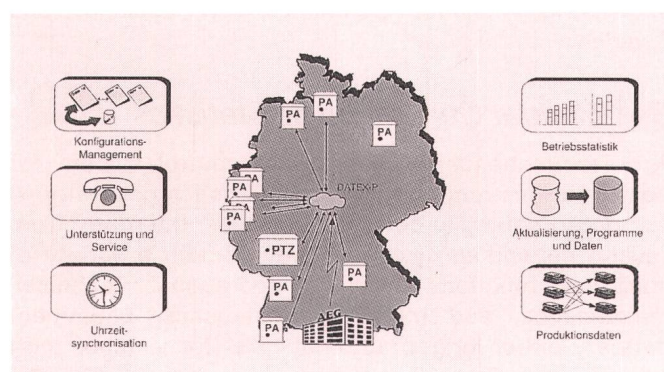

Fig. 6 Network of the Deutsche Bundespost's mail service
Konfigurations-Management — Configuration management
Unterstützung und Service — Support and Service
Uhrzeitsynchronisation — Time synchronization
Betriebsstatistik — Operational statistics
Aktualisierung, Programme und Daten — Software and data updates
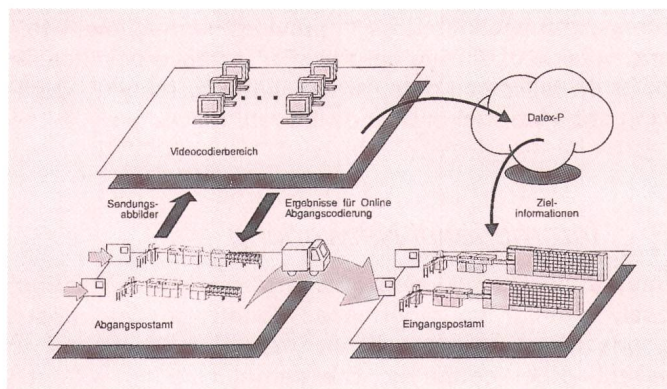Produktionsdaten — Production data

Fig. 7 *Video encoding system and the transmission of its encoding results*
Videocodierbereich — Video encoding area
Sendungsabbilder — Images of goods
Ergebnisse für Online-Abgangscodierung — Results of on-line encoding at point of origin
Zielinformationen — Destination information
Abgangspostamt — Originating postal centre
Eingangspostamt — Destination postal centre

Fig. 8 *Quality monitoring of the lettermail service*
Messpunkt — Measuring point
Daten — Data

rectly from a terminal in Konstanz. Systems supplied to Austria, Canada, Denmark, Germany, and New Zealand are already attended by this service.

Another interesting feature of nationwide networking concerns video encoding and transmission of the coding results *(see Fig. 7)*. Encoding is the second processing stage within automated mail processing and is effected by coding equipment which uses highly complex systems to transform the destination addresses to a simple machine-readable barcode. This address evaluation process is carried out automatically either by the automatic address reader or, in the case of addresses resisting automatic recognition, in video coding systems. In the latter the address image is presented on monitor screens to video coding operators who key the address elements manually via a comfortable keyboard into the computerised system. When the specific barcodes, which represent the destination addresses, are printed onto the mailpieces they are ready for final sorting. In the subsequent sorting phases the barcodes are read, evaluated, and fine sorted by high performance sorting machines.

To utilise the otherwise unproductive mail transit time for encoding, for those mailpieces whose destination the automatic address reader could not recognise completely, only the postcode is encoded. This allows immediate presortation and transportation to the destination post office. At a point later in time inward video encoding (street, house number, PO box) is done based on the electronically collected, but not fully evaluated addresses. The encoding results are forwarded to the destination post office via computer network while the mailpieces are physically on their way to it, to be assigned, in additional sorting runs, to the mailpieces which have meanwhile arrived in the post office. In those cases where in the processing plant only a short period of time is available for sorting and if many keyboard entries are required for inward encoding, this concept offers enormous time advantages by parallel utilisation of mail transit time.
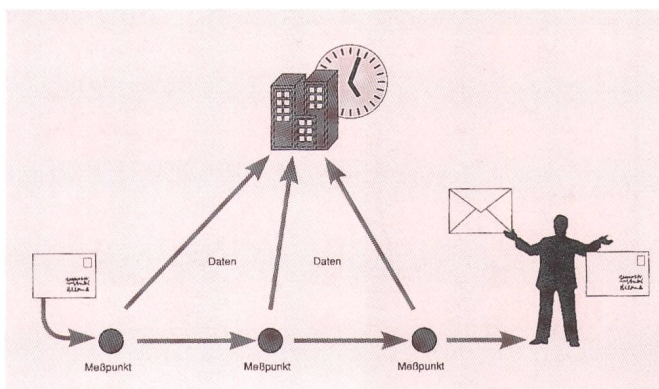
8 Post Goods Management Systems

Mail transportation within promised periods of time (such as next business day delivery) is an essential quality feature of the postal service. For quality measurement and assurance AEG has conceived an extensive system called QMS (Quality Management System). This system *(see Fig. 8)* measures continuously and automatically letter transit time within the mail flow wherever it passes through. For this purpose an identification is used permitting the determination of time at each measuring point and to evaluate it centrally or at a decentral point. Measurement and evaluation may be made in a sampling method or continuously. The results are statistically representative.

In addition to that a selective analysis of the mail flow is possible using electronic quality test letters which record all mail movements *(see Fig. 9)*. For this purpose a normal letter is provided with an accelerometer and a processor. The movement profiles recorded are evaluated, and comparing the results with nominal curves allows conclusions as to bottlenecks and deficiencies within the mail flow. Such test letters and the time taken for reaction to deficiencies noted can be centrally evaluated via the network.

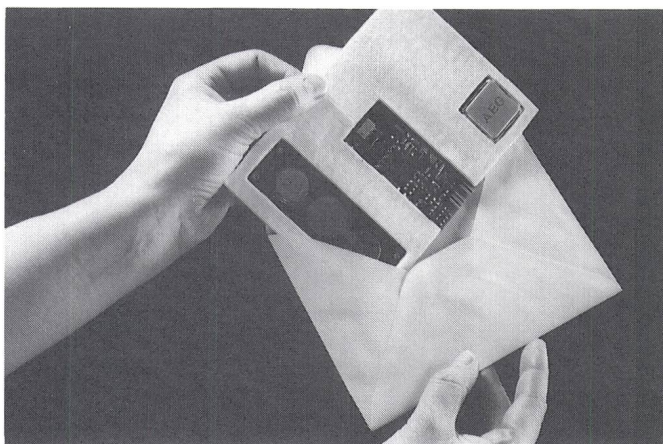The use of such complementary systems opens new roads to effectively ensure the service quality and to

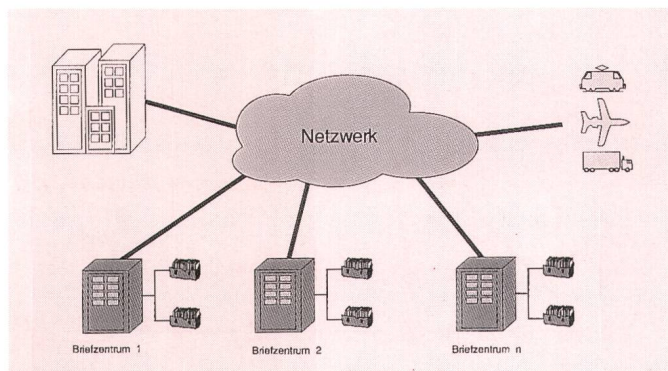Fig. 9 *Transit time measuring letter*

Fig. 10 Optimised mail service process
Briefzentrum — Lettermail centre

systematically remove deficiencies within postal logistics.

An expanded, continuous quality measurement allows complete mail tracking. With this procedure, called *Tracking and Tracing,* the status of each single piece of mail can be instantly determined. It simplifies the proof of delivery, and effectively supports investigations where mail has not been delivered in time or has become lost. It is also optimally useful for registered or value mail.

Another large field of application is the automation of the transport and time management *(see Fig. 10).* Under its name *Optimised Mail Processing,* a number of features are consolidated for improving the mailflow within and outside of sorting centres. For instance advance reports on mailpiece data for capacity and resource planning are accepted or acknowledged, respectively.

9 International Networking

International networking of postal services is continuously gaining in importance. Country-specific postal goods management systems may thus be linked to several other countries. The communication with the other countries is managed by the national centre concerned. International networking facilitates the determination of border-crossing mail volumes and processing of payments based on the respective volumes. Transit time measurements for service quality enhancement will be possible across the national borders, and electronic mail tracing, particularly of registered mail, from origin to destination increase the postal services' attractivity in comparison to other communication technologies.

The development of international data exchange is supported by the European Community within the scope of the *CAPE Project* (Computer Aided Post in Europe). AEG is partner to this project. This procedure is based on the electronic exchange of mail-specific data (such as the number of mail sacks) between the partner nations. The Deutsche Bundespost's air mail processing centres in Frankfurt/Main and Düsseldorf have been equipped with this system by the end of 1993.

Zusammenfassung

Lokale und landesweite Informationssysteme automatisieren die Postbearbeitung

Die Marktanforderungen an die Postdienste werden immer grösser und vielfältiger. Neben dem Briefaufkommen steigt auch die zu befördernde Menge an Paket- und Kleingut. Die Postbearbeitung muss weiter beschleunigt und automatisiert werden, um dem steigenden Druck durch Mitbewerber auf die Postdienste zu begegnen. Neue Verfahren zur Optimierung des Sendungsflusses innerhalb und ausserhalb der Bearbeitungszentren sind gefordert. Die AEG Electrocom in Konstanz liefert deshalb nicht mehr nur einzelne Sortier-, Codier- und Verteilmaschinen als Insellösungen, sondern hat neue, übergreifende Leit- und Informationstechnologien entwickelt. Strukturen aus der Industrie, beruhend auf dem CIM-Modell (Computer Integrated Manufacturing), sind auf die Postwelt angewandt. Daraus ist das CIPS-Konzept (Computer Integrated Postal System) entstanden, das verschiedene neue Anwendungsbereiche bietet. Die Angebotspalette für lokale und landesweite Informationsverarbeitung umfasst bereits heute zentrale postamtspezifische Steuer- und Überwachungssysteme, landesweit vernetzte Lösung zwischen den Briefzentren und neue, darauf aufsetzende Postgut-Management-Systeme zur Qualitätsmessung und für optimierte Sendungsabwicklung. Sie verbessern die Leistungsfähigkeit und Güte des Postdienstes.

Résumé

Automatisation du traitement du courrier par des systèmes d'information locaux et nationaux

Le marché pose des exigences toujours plus élevées et plus diversifiées aux services postaux. Le nombre des lettres, des colis et des petites marchandises à transporter ne cesse d'augmenter. Il s'agit d'accélérer et d'automatiser plus encore le traitement des envois postaux pour parer à la pression croissante de la concurrence sur les services postaux. De nouveaux procédés permettant d'optimiser le flux des envois au sein et à l'extérieur des centres de traitement s'imposent. C'est pourquoi AEG Electrocom à Constance ne se borne plus à livrer des installations de tri, de codage et de répartition en tant que solutions partielles, mais développe de nouvelles technologies globales d'acheminement et d'information. Des structures industrielles fondées sur le modèle FIO (fabrication intégrée par ordinateur) sont adaptées aux besoins postaux. Il en a résulté la conception CIPS (Computer Integrated Postal Service), qui offre des champs d'application nouveaux et divers. Pour le traitement local et national de l'information, on offre aujourd'hui déjà des systèmes de commande et de surveillance propres aux offices postaux, à savoir des centres de traitement de lettres associés à des systèmes de gestion des envois postaux permettant de mesurer la qualité du service et d'optimiser l'acheminement du courrier. Ils améliorent les performances et la qualité du service postal.

Riassunto

Sistemi di informazione locali e nazionali automatizzano il trattamento postale

Il mercato pone ai servizi postali esigenze sempre più elevate e svariate. Oltre al volume delle lettere aumenta anche la quantità di pacchi e di merci di piccole dimensioni da trasportare. Per far fronte alla crescente pressione esercitata dai concorrenti nei confronti dei servizi postali, bisogna accelerare il trattamento postale e automatizzarlo. E necessario introdurre nuovi sistemi che ottimizzino il flusso degli invii all'interno e all'esterno dei centri di trattamento. La ditta AEG Electrocom di Costanza non fornisce più singole macchine di smistamento, di codificazione e di distribuzione quali singole soluzioni ma ha sviluppato nuove tecnologie in cui sono integrati l'avviamento e l'informazione. Le strutture create dall'industria, basate sul modello CIM (Computer Integrated Manufacturing), sono ora adottate anche dal mondo postale. Ne è nato il concetto CIPS (Computer Integrated Postal System) che offre diversi nuovi campi di applicazione. La gamma delle offerte relative al trattamento locale e nazionale delle informazioni comprende già oggi sistemi di comando e di sorveglianza centrali, specifici per ufficio postale, una soluzione interconnessa a livello nazionale fra i centri di smistamento delle lettere come pure nuovi sistemi di management delle spedizioni postali, basati su questa soluzione, per valutare la qualità e ottimizzare la spedizione. Essi migliorano l'efficienza e la qualità del servizio postale.

Summary

Local and Nationwide Information Systems Automate the Postal Processing

The market demands on the postal services are increasing and becoming more varied. In addition to the emerging flood of letters, the number of parcels and small items to be transported is increasing, too. The postal goods processing has to be accelerated and automated still more in order to meet the increasing pressure of competitors in the postal service. New methods for optimizing the flow of goods inside and outside the processing centres are called for. That is why AEG Electrocom in Constance does not only deliver individual sorting, coding and distributing machines as single solutions but has developed new routing and information technology. Based on the CIM model (Computer Integrated Manufacturing), structures from this industry are applied to the postal world. From this the CIPS concept (Computer Integrated Postal System) has emerged which offers various new areas of application. The range of solutions offered for local and nationwide information processing covers already today central control and monitoring systems specifically designed for post offices, nationwide network solutions linking the postal centres and, based on the above systems, new post goods management systems for measuring quality and for optimized parcel handling. They improve the efficiency and quality of the postal service.