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# Online Infrastructure in Supply Chain for Hardware Shops

## A solution for 260 hardware and DIY stores based upon DATEX (X.21)

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**Abstract.** This article describes how the Scandinavian network communication system DATEX was used to build an online infrastructure in a retail chain of privately owned hardware shops and Do-It-Yourself (DIY) centers. The solution gave the staff in the shops the possibility to use EDP as early as in 1983. The Internet did not exist at the time. EDP was not part of the daily work in the shop and was for most employees something unknown that took place at the headquarters. The DATEX solution made it possible for shop assistants to do online order entry which gave the store employees knowledge of EDP. Delivery time became available to customers, when an item was sold out. Price calculations were available online, and the distribution center got an online communication system to all the shops. End users were involved in the development process already from the beginning, one of the main reasons for the success. Companies in the hardware and Do-It-Yourself businesses merged during the 1980s. Communicationssystem played an important role when decision about the administrative solution was taken. The solution has been developed much through the years and is still being used. The Internet is the current communication system and the application programs are based on a web platform.

## 1 Introduction

In the 1980s DIFA was a chain of 260 independent privately owned hardware shops and Do-It-Yourself centers. The yearly revenue in the shops varied between 2 and 50 million Danish kr. Owners of one or more shops each had one share in the distribution center for all the shops.



The management and the board went on a business trip to US in 1982 where they

visited a business connexion - Home Hardware. The hardware business worked on developing a new order switching system. Hardware shops and DIY centers transmitted orders batchwise to an EDP system that distributed the orders to connected vendors of hardware and building materials. The US visit was a big inspiration for the management and resulted in bigger EDP investments at DIFA. Rationalization and merge of retail chains was expected, and the management and the board developed a strategy to bring the members (shareholders) closer together. They wanted to build a data forum where DIFA differed from others in the business.

The main task of a retail chain is to establish contracts, prepare marketing materials and deliver goods to the stores. All purchase chains could do this and the bigger stores had the resources to do the work even by themselves, which was one of the major challenges in the chain.

DIFA should therefore be able to offer something that was not technically and economically feasible to smaller competitors and the bigger stores to develop.

An online communications network to shops and vendors were selected as the strategy.

## **2 Online Communication should make the Difference**

The internal EDP systems at DIFA were efficient, and EDP was chosen to be the area, where DIFA should make a difference to the competitors. In 1982 EDP had not been implemented in retail shops. Invoicing and bookkeeping machines was the normal equipment.

DIFA was going to offer an online communication network, by which all the 260 shops were connected to the distribution center. The online network should provide the shops with new services to give extra customer services. Basically the online system should provide the following functions:

- To give the shops an online real time order entry system. It was also the ambition to build order entry functionality directly to suppliers of building material, in a situation where products were not delivered from the central distribution center.
- To give the shops information on the precise delivery time. If an item was temporarily sold out, it should be possible to inform the customer when to come and pick it up and the price of the item.
- To give the shops an easier method of finding information on updated prices to be used in price calculation, printing price stickers and updating the prices for the invoicing systems.

### 3 X.21 Communication Network

I was the EDP manager at DIFA, and I was convinced that the cost and functionality of future communication network was very essential to achieve greater success. We decided early in the process that individual shops should pay the actual network cost directly to the P&T based upon consumed resources. The shops had very different economic sizes and cost was important to them. The success of the system was very dependent on the cost for the shops.

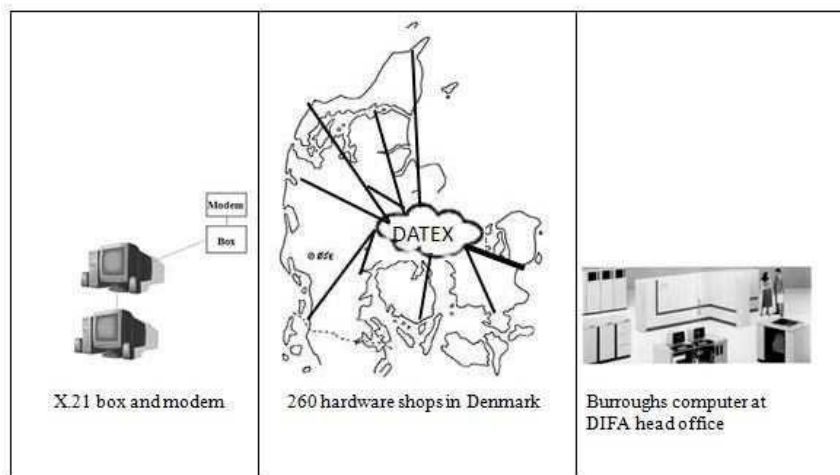
One of the first sources of inspiration came from the book selling industry. In the 1970s a publishing house – Gyldendal - developed a communication network for the booksellers. The network was based upon a DATEL multipoint communication network with leased lines and concentrators placed around in Denmark. The solution was very complex with high fixed cost. To reduce cost to the booksellers it was also possible to dial up to the network. In that case it took minutes to connect, and the response time was poor. The data rate was as low as 1200 bits per second.

Dansk Dataforening hosted a conference in November 1982 where the new Nordic communication network DATEX (X.21) was described. The DATEX system was a circuit switching system, running full duplex with a data rate up to 9600 bits per second. Connection was very fast and in the order of milliseconds. Transmission cost was calculated only for the time when the line was connected. Line cost was the same regardless of geographical distance within Denmark. It was a very flexible system. The shops subscribed to DATEX modems with direct call functionality to the central EDP. All complexity concerning lines, multiplexers and concentrators was P&T's responsibility. The EDP department was only responsible for modems at the central site.

The application system was designed to minimize the connection time. Transmission cost was charged to the user only during the time the system was retrieving and transmitting data. The DIFA head office and distribution center were located in the Copenhagen area. The 260 shops were located all around Denmark, and telephone cost was a political issue due to geographical distances. The telephone cost doing ordering to DIFA from the western part of Denmark was higher than from the east part, and that was subject for discussions and the DIFA location. The DATEX price model with same price regardless the distances was a competitive advantage for the DIFA system.

DATEX was available only in Scandinavia and Germany and there were few suppliers of computer terminal equipment. DIFA had good relation with the Danish subsidiary of Burroughs Corporation. The company agreed to develop an interface box between a DATEX modem and a Burroughs Terminal. The function of the box was to send a signal to the modem to establish a connection, when a user pressed the transmit button on the computer terminal. The central computer disconnected the

circuit, when print or a response to the terminal was delivered. The logical connection was open all day without cost and the transaction cost was about 0,05 Dkr. each. The shops could have more computer terminals and a printer connected to one DATEX modem. A comparison between a DATEX solution and DATEL showed that a shop could have up to 1000 transactions per day, before a leased line was more cost efficient and even without counting on the advantage, that DATEX was much more flexible and that the P&T did the invoicing. This external invoicing reduced a great deal of internal discussion about communication cost.



**Fig. 1. DATEX network with computer screens, special X.21 box, modems and central Burroughs Computer In 1983**

#### 4 Order Entry System

The EDP department realized from the beginning that it would not be a success offering the old internal systems to the new external customer group. It was extremely important that the user interface was simple and tailored to the user(s), who had a lot of other tasks to do in the shop. They would be only occasional users of the new online system. All data in the system were created and maintained by internal users at DIFA head office and normally only used by a small number of employees. The new system gave access to data to a much broader range of users, and the importance of updating data was evident but not always that popular. Employees at DIFA head office – specially in the buying department – got extra job to do for benefit in other departments - at customers and in the EDP department. At that time it was new to the middle management in buying departments.

In 1980s Index sequential was the normal access method to a data file. When a user is looking for an item in the database system correctly spelling of the name is

needed and it can be difficult for an occasional user to work with a product file.



The EDP department developed methods for free text queries and it became a great success. Users simply types Margrethe or a part of the word and in few seconds all Margrethe bowls with different colors and sizes were listed on the computer terminal including delivery time. All web shop systems include that functionality now 20 years later.

**Fig. 2.** Information is available online

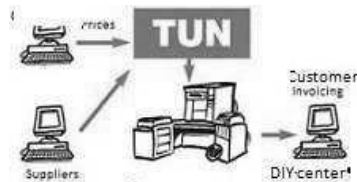
Selected product ranges were available only for certain customer groups and filtration systems were developed, so a store could only see and order the products which were available for just that store and to the individually agreed price.

The order entry system controlled the entire order books. Christmas gifts, e.g., were ordered midsummer and delivered to the shops several months later. Invoices were archived in the system and it was easy to find invoices concerning earlier deliveries and their prices. By using this system the shops could get better estimates of future deliveries, which was not an easy task, when no purchase system was implemented even in bigger DIY centers.

## 5 TUN Product Database

The system also contained an industry database of 100,000 building materials, numbers, names and prices from 500 suppliers. The database was updated weekly. The stores got electronic mail with information when a supplier had updated the products. With a single keystroke a DIY store could print their own price lists or price tags with individually calculated and rounded retail prices – which previously was often neglected or postponed "until we have the time."

TUN –Timber trades Union- are the trade association for the building centers. The members are DIY centers across Denmark and suppliers of building products. The membership gives the possibility for the suppliers to market products in a common product database and gives the DIY centers the right to access the database.



**Fig. 3.** TUN product database is the fundament of the data structure in the DIY business.

The system's ordering function for different suppliers was never a success. The suppliers were very different and their order and pricing systems were developed only for internal use. It was not constructed for external use, and it was not possible to develop a standard system which could address all the different business needs and still being easy to use. There was also a significant resistance in the sales department at the suppliers. The sales staff was also afraid to lose contact with the stores on a daily basis. Their salary depended on orders taken.

## **6 User Involvement in Development**

The Board was very dedicated to the vision and helped to identify five test stores that were involved in the development phase already from the beginning. Test installations were selected geographical nationwide: two from hardware shops and three from DIY centers. The selected test stores were highly regarded within the industry. In the test stores designated test users with good product knowledge were pointed out. Ideas and prototypes were tested with test users during the development phase. The development took only ½ year - starting in November 1982 – and the system was in operation in April 1983.

## **7 System Release 1983**

The announcement took place in March 1983, and the installation of test users was carried out in April 1983. Installation of other users started August 1983.

I was the IT manager at DIFA in the period 1979 – 1989, responsible for project management, development, and deployment of the new online solution.

The project was kept secret until 7 March 1983, when there was general meeting in DABYFA - a DIFA subsidiary known as HANDY. All the building material suppliers were invited to a meeting after the general meeting. It was the first time that DIFA arranged a meeting where all the suppliers were gathered with all their customers in the chain.

The only item on the agenda was the presentation of DIFA Terminal System (DTS). I had prepared a live demonstration where the system was showcased with a large screen projector to an audience of 200, and I still remember the thrill in the room as the system appeared on the large screen.

Large screen projectors at this time were not so good, and the room had to be almost dark - but the effect was even greater when the free text search "blue nails" resulted in all the products, where the words nail and blue was found in the name.

Prices of products contained the buying price and suggested retail price calculated individually with consumer- friendly rounded prices. The user could just type a number in front of a product number, and then the product was ordered.

The large screen was new for most people. The free text search was brand new. The audience had not seen such a user- friendly system before. It was never seen before and not on a large screen.

DTS require a product database with all building materials from different suppliers. The database was under construction within the industry. But the enthusiasm at the building material suppliers was not strong and it was difficult to maintain the discipline in submitting updated product information. But a live online demonstration of the suppliers' products to their customers - the directors of DIY centers - had an amazing effect. They could all see the idea and the future use of the database. DIFA contributed a lot to the realization of the TUN Product database.

This system is still being used today (2014). The only difference is that prices are no longer printed on paper, but downloaded onto local invoicing or cash register systems. The database contains 500,000 updated product data and is the nerve in the supply chain in the DIY industry. Building a product database has subsequently happened in Norway, using the model from Denmark.

## **8 Test Installations**

The system was installed in five test shops a month after release. Test users have played a very important role. One of the key factors was where the equipment had been placed. Accounting and invoicing machines were always placed inside the office far away from the customers. But this equipment should be placed in the store, not by the cash register, but as close as possible to the customers, so that the staff could use the system in a customer expedition. The shops liked to demonstrate the system to customers, and the employees were very interested in using it. The staff got an easy way to get access to knowledge of EDP. It was now something that could be used and not just something that took place in the office.

DTS solution was very easy to use without any prior efforts with data entry and related disciplines.

Applications were used by the shops assistants and often close to customers. Not all information was meant for customers in the shop - sales margin etc. It was necessary to have various screen pages depending on whether the terminal was used together with a customer..

In the retail business everything has to be fast and simple. Time is not available for logons and flicking through several menus on a screen terminal. Users log on once a day and the central system kept the session running all the day.

The "stupid display terminals" had multiple logical pages, and the systems was modified in a way so that the user could work with more pages simultaneously, simi-



larly to multiple windows in the PC world more than 10 years later.

*Example.*

Page 1: relevant to customer      Page 2: only for internal use  
The user could with one keystroke switch between pages and applications.

DIFA's EDP department was organized in a consultant, operation, and development department.

Programmers and consultants were involved in the first test installations. It was very encouraging for the programmers to see, how their solution was received in the shops. They have gradually become much more positive to accept and implement changes.

The consultant department sold systems, managed the installations of equipment, and supplied hotline and support to the shops. Class courses were not given, but the necessary instruction was given in connection with the installation. All the consultants were recruited from the retail sector which had a very import positive influence.

The DTS solution was widely distributed in the hardware- and DIY industry. Several mergers of chains happened in the retail industry, and there were about 500 installations in the late 90s. One of the success factors was system optimization and easy terminal access from the beginning. Computer terminals were placed in the store, and when a customer requested for a product not available in the store, it was easy for the staff to find information on the product - when it would be available and at what price. It was very professional at the time and increased the sale. The staff was very happy with the system even if some older shop owners did not want the staff "to watch Television" during work hours.

## **9 Mergers**

IMERCO was another big player in the hardware business. IMERCO had also invested in online systems. They had chosen Tele data. The concept was a Videotext service (a kind of interactive television). The user connected Tele data via a modem, keyboard and a Television monitor. The system was inspired by the French Minitel.

When IMERCO and DIFA merged in 1989, it was the DIFA EDP technology and architecture which was chosen as the continuing solution. The reason was that the DIFA DTS was much faster than Tele Data. DIFA solution included many functions for the DIY centers, and this played an important role in the decision. Tele Data was never a success and the technology was shut down in 1997. The Videotext service is still used as Teletext by many Television channels.

In the 1990's the DIY chain HANDY was merged with Danish Interpares. DENDEK became also part of the group of the independent DIY stores in 2000's. They got the new name XL-BYG which is also marketed in Norway and Sweden

## 10 Communication Development

Danish Interpares consisted of the biggest DIY centers Their EDP strategy was based on IBM technology with distributed system/36 and AS 400 computers. The central computer was an IBM mainframe with SNA and 3270 user interface. It was decided to use the DIFA applications. The systems in their head office (DITAS) could be accessed from the distributed network and the local computers.

A great effort and many resources were used to integrate the Burroughs user interface in a SNA 3270 environment. Print management through the complex network was especially very challenging!

PC's were widely distributed in the 1990s, and the Burroughs computer screens were replaced by PC's with screen emulators .It seemed profitable to buy a PC and use it for bookkeeping and for screen emulation. But bookkeeping was normally going on in the back office by a bookkeeper. It was particularly inconvenient for the staff to use the equipment placed in the back office in a customer service situation – just as experienced 15 years earlier.

The economy was especially important to the smaller shops. These shops bought only one PC, despite our recommendation, and the PC was only used by the shop owner during the evenings for order entry.

The ISDN network started to be marketed in 1992. It had the same fast connection time as x.21. ISDN circuits consist of two logical circuits. The first can be used for phoning and the other for data transmission. X.21 modem was not necessary any more, and the shops saved subscription cost for a telephone line.

The original DIFA communication network was migrated from X.21 to ISDN in the late 90's.

## 11 Application Development

A *wish list* was a nice little application, which was used a lot in gift shops in connection with weddings, confirmations and birthdays. The shops advertised in catalogues and newspapers that bride and bridegroom could come to the gift-shops with a wish list. All the wishes were keyed in and they could tell the guests that they can go to any INSPIRATION shop in Denmark and find an updated wish list. The shops were responsible for updating the list when an item from the list was sold. The guests were able to get information about which gifts already were taken by other guests. A lot of double gifts and changes were prevented.

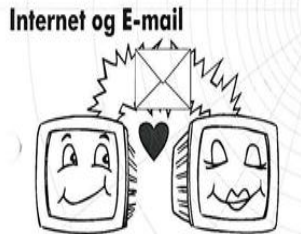
The system was very valuable to the shops, which had calculated that every new wish list created a sale of about 25.000 dkr. DIFA did not monitor the systems during the weekend, and experienced complains and emergency phone calls from the

shops especially when the system wasn't working during weekends. The shops claimed to have lost sales for 25.000 dkr. The problems were caused by technical issues with the ISDN interface and the data communication controller. The terminal could not get in contact with the mainframe and the communication line had to be reset.

Internet became available in the later 1990s, and the web applications were developed using the TCP/IP network protocol.

The order entry system was the first which was converted to the web, and gradually more functions were added to the system. The web shop is still used B2B (business to business) by F&H who supplies products to hardware stores in Norway and Sweden. F&H is one of the biggest suppliers of glass porcelain and kitchenware in Scandinavia.

The XL-BYG DIY chain still uses a heavily expanded web version of the original



**Fig. 4. Internet is the current communication structure.**

DTS version with access to the TUN product database. XL-BYG produces weekly advertising brochures which are distributed to all households. All information about products such as description, prices and pictures in these brochures is available and updated in the system.

This system informs the stores about the products in the advertising, and the DIY stores do their ordering through a web system based on a Microsoft enterprise platform. Prices and bar codes to the cash register are also delivered by the system.

The Internet was the communication network

from 2002

## 12 Summary

In the 1980s DIFA was a chain center for 260 independent hardware stores and DIY centers. Management wanted to bring the members closer together in a data forum and give the members up to date information on products, prices and distribution in order to improve their customer service.

The internet was not available at the time but the Scandinavian Datex system (X.21) was just released in 1982. The system offers connection time in milliseconds, high transmission rate and the charge was the same as standard landline charge – but only charged when connection was established. The P&T was responsible for establishing and operating the network.

X.21 system was Scandinavian, and terminal equipment available to be connected was very limited. In cooperation with the machine supplier Burroughs Data Systems a box was developed to interface one or more Burroughs terminals to a X.21 modem.

The applications were order entry systems, price lookup and price calculations. DIFA sys-

tems were extended with modules and functionality such as free text search like in web shop systems that became widely available in 2000 and beyond.

Approximately 500 businesses across the hardware and DIY industry used the system. One of the major success factors was customization to the businesses needs and terminals made available onsite in the shops. The system was a huge success amongst the staff. The introduction of this new system in the early eighties exposed the retail staff to technology, which otherwise was something that was only available to the head office and administration staff.

The system also contained a database with 100,000 building materials numbers, names and prices from 500 suppliers. Businesses received electronic mail weekly with information about the suppliers and what products they had updated.

The system put pressure on suppliers to ensure that product prices and availability was updated on a continuous basis. The system is still used today. The only difference is that the prices are being downloaded into the local IT / invoicing systems.

The outlined system has inspired supply chains and purchasing groups in the rest of Scandinavia - for example Jernia in Norway and Sweden

The system's concept is still used in 2014 for example in XL-BYG and some hardware stores - implemented via the Internet and based on the Microsoft platform with browser-based web shop baskets.

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