A Hybrid Checkout System

Final report of the bachelor assignment for Industrial Design by Tycho Hartman

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Author: Tycho Hartman
Study: Industrial Design
Student number: s0095184
Address: Amundsenstraat 6c, 3814WV Amersfoort, The Netherlands

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Institute: University of Twente
Faculty: Construerende Technische Wetenschappen
Study: Industrial Design
Address: postbus 217, 7500 AE Enschede, The Netherlands, tel. (053)4 89 91 11

This report is intended for the tutors and the graduation professor.

Tutors:
H. Boiten Msc., Scanpoint B.V.
Ir. M. Brouwer, University of Twente

Professor:
prof.dr. ir. A. de Boer, University of Twente

Abstract

This report describes the methods and results of the bachelor assignment by industrial design student Tycho Hartman. The assignment was executed at the company Scanpoint in Amersfoort (The Netherlands). This company sells and services electronics and software for self checkout solutions in supermarkets. Self checkouts are automated checkouts in supermarkets that allow the customer to register and pay for supermarket products without the aid of a supermarket attendant. One of the weaknesses of current self checkout systems is that customers take more time to scan the products than trained supermarket attendants. The goal of this project is to design a self checkout system that can also be used by an attendant to speed up the checkout process when it is busy in the store. Such a checkout system is called a hybrid checkout system in this project because it combines functionality of a conventional attended checkout and a self checkout. First, preliminary research is done into the market for checkout systems and self checkout systems. The users of these systems are interviewed and the way the systems are used is observed. This research leads to requirements for a hybrid checkout system. The most important requirements are that (1) the system cannot take up more floor space than a conventional attended checkout, (2) the users require the system to work exactly like a self checkout system when it is in self checkout mode, and exactly like a conventional attended checkout when the system is in attended mode, and (3) the system must provide good ergonomics to reduce strain and work related injuries for the attendant. These requirements are used to create six technical design concepts for a hybrid checkout. Parallel to this, four photo collages were created to investigate the styling that can be used for a hybrid checkout system. The decision was made to investigate three different styling options: a High tech styling, a Modern styling, and a Friendly styling. These three styling directions are applied to three of the six concepts that were created. The concept selection is based on commercial and technical insights of the author and the people at Scanpoint. The three selected concepts, each with a styling direction applied, are developed further into three design proposals for hybrid checkout systems. These design proposals are used to estimate the economic feasibility of a hybrid checkout system. An evaluation of the three design proposals is done to investigate the result of the project. The most important conclusion of the evaluation is that the design proposals are what Scanpoint expected them to be. The report ends with the conclusions that (1) hybrid checkout is technically and economically feasible, (2) there is room in the market for such a system, (3) the requirements that were formulated are useful for further development of hybrid checkouts, and (4) the styling directions and the design proposals are a useful inspiration for checkout manufacturers seeking to develop a hybrid checkout system.

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Introduction

This report marks the completion of the bachelor assignment of Tycho Hartman, an Industrial Design student at the University of Twente in The Netherlands. The assignment has been issued by Scanpoint in Amersfoort, The Netherlands, and involved the preliminary research phase and the conceptual design phase for a checkout system for supermarkets.

Scanpoint is a company that sells and services essential hardware and software for a proprietary checkout system that allows supermarket customers to scan their groceries and pay for them with very little assistance of a store attendant. This so called self checkout system provides the shopkeeper with a reliable and secure way for checking out groceries. The self checkout solution allows one attendant to supervise up to eight self checkout systems, which is a great advantage over regular attended checkouts that require one attendant at each checkout. The self checkout systems also take up less floor space in the store compared to regular attended checkouts. The benefits of this self checkout system for the customers are that there are more checkout lanes open at any given moment, thus allowing more customers to checkout simultaneously without having to wait in line. The self checkout process also provides the customer with more privacy because there is no longer an attendant that processes every single product they wish to purchase.

The self checkout process, however, has a weakness on a very basic level that has caused shopkeepers to delay implementing the system or refraining from the implementation altogether. This weakness is that customers, however experienced they may be with the self checkout system, cannot scan the products as fast as a trained attendant. At peak hours, this causes lines to form at the self checkout systems that do not dissolve as fast as they would at an attended checkout. Because the self checkout systems often take up floor space in the store that would otherwise have been occupied by regular attended checkouts, the number of regular attended checkouts that a store has, alongside the self checkout systems, is not sufficient to eliminate the lines at these busy moments. Therefore, shopkeepers have asked for a variation of the self checkout systems that allows an attendant to take over the scanning from the customers to speed up the checkout process. Such a system is dubbed a hybrid checkout system, as it bundles features from both regular attended checkouts and self checkouts.

Scanpoint provides essential hardware components and software for self checkout systems. The checkout system itself, which also consists of the housing for these components and the some mechanical parts, is built by various checkout furniture manufacturers that each offer a model that is slightly different from the others. A hybrid checkout system, as requested by the shopkeepers, could be built by checkout manufacturers using the existing Scanpoint offerings with some minor modifications. However, thus far none of the checkout manufacturers has made an effort to design and build such a hybrid checkout system.

The purpose of this study is to research the options for such a hybrid checkout system and to do some design proposals that can inspire the checkout manufacturers to design and build such systems. This is done by investigating the market for checkout systems, researching into the needs of shopkeepers, supermarket attendants and customers and defining requirements for hybrid checkout systems. With the data that is collected, various design concepts are created. With the aid of photo collages, the desired styling for the hybrid checkout is investigated. This styling is then applied to the concepts that are considered most interesting and inspiring, which results in multiple design

proposals for a hybrid checkout system. Finally, an approximation of the sales costs for the hybrid checkout system was made.

This report ends with conclusions on the design process of the hybrid checkout system. Also presented are recommendations for projects that follow up on this study. To conclude the final chapter, the author does a personal evaluation.

1 What is the current market situation for Scanpoint?

1.1 What are checkout systems?

Most modern day supermarkets are based on the self service principle. This means that the customer can walk freely through the store, searching for the desired products in the various sections of the supermarket. The desired products are usually carried in a shopping cart or shopping basket. When all groceries are picked from the shelves, the customer has to pay for them. This is done in the checkout area, usually the area closest to the exit of the store. It is quite common that the customer can only leave the store by traversing the checkout area, to ensure that all products chosen in the store are being paid for. The checkout area of an average sized supermarket consists of a number of checkout desks and often also has a customer service desk. In this project, the focus is on the checkout desks, but to explain the working of the supermarket, a wider view of the store is sometimes applied. The checkout process is the process of paying for the groceries and all underlying processes, such as registering the products, making the monetary transaction, etcetera. From this point on, the term checkout is used for both the checkout desk as the checkout process, depending on the context.

1.1.1 Conventional checkout and self checkout

A relatively new development of the checkout process is the move towards self service checkout, also known as self checkout or self scanning. The conventional checkout procedure is facilitated by a store employee (a cashier) who helps the customer register the products, calculates the due fee and accepts the payment. Generally, for each customer that checks out, one store employee is required. To minimize labour costs, a new checkout process is developed and introduced to the market. This new checkout method is called ‘self checkout’ and allows the customer to execute most (and sometimes all) checkout tasks, without much help from an attendant. This functional concept requires different checkout systems that replace the attended checkout desks of the conventional checkout process. It allows one store attendant to service multiple checkout systems and thus can help save labour costs. The upside of this new checkout process is more privacy for the customer and the perception of a more speedy checkout. The store can process more customers simultaneously and thus reduce the waiting lines, without having to increase the number of cashiers.

1.1.2 The purpose of the checkout

Now that the checkout process is clarified, a more in-depth look at the purpose of the checkout is offered.

1.1.2.1 Allow for payment

The primary reason for the checkout to exist is to allow the products from the store to be paid for. A checkout usually has a cash register to securely store the received money as well as the change money. Another feature of the cash register is to aid the cashier in calculating the due fee and the change money.

1.1.2.2 Register products

In order to calculate the total amount of money a customer has to pay, each product is scanned into the cash register. This tells the register which product it is, and the register then searches the central product database (on a local computer server) for the product’s name and price. The price and name are added to the receipt that will be printed for the customer. To keep track of the store inventory,

the turnover and lost products, the sold items are also registered in a separate database after the transaction. Modern day information technology is applied in many stores to automate the ordering of new product stock, a system which is heavily depending on the correct registering of all sold products at the checkouts. The described 'cash register system' is often called the Point-of-Sale system or POS system in technical terms. The term POS (without system) is also used in more informal situations.

1.1.2.3 Extra services

At the checkout, a host of extra services to the customer are provided. Depending on the store, the offerings at the checkout vary from plastic bags, discount products and packs of gums to prepaid telephone cards and cigarettes. It is also quite common for a chain of stores to have customer loyalty cards which give the customer a way to save credits and get extra discounts, among other things. Often, these loyalty cards are also used by a store or chain to get purchase statistics from their customers for marketing purposes.

1.2 How is the market for checkout systems organized?

Based on conversations with Scanpoint employees, an overview of the market has been drafted. A supermarket nowadays is a very complex and versatile environment in which products and services of many kinds, shapes and forms are traded. The supermarket is furnished with various different objects and systems, varying from store shelves to checkout furnishing and cooling installations. The checkout system and checkout furnishing are the focus of this project. Usually, a shop fitter selects the furnishing and systems to be installed, keeping in mind the requirements of the store owner. The shop fitter is the party that ties supply and demand of supermarket systems together.

1.2.1 Supply of checkout components

On the supply side of checkout systems, there are various parties. Most of these parties offer hardware and software solutions that can be built into the checkout furnishing that is designed and produced by the shop fitter. Shop fitters usually are the designers and manufacturers of the checkout furnishing. The mentioned hardware and software solutions can be cash drawers, barcode scanners, keyboards, displays, cash register electronics etcetera. Aside from these hardware parts, software is of growing importance in the checkout systems and as such is an important product for the manufacturers of checkout components.

The suppliers of self checkout systems usually deliver their products as a whole, complete with enclosure, rather than as individual parts. This means that the shop fitters have little freedom in fitting these systems into other furnishings, and their options for combining parts to create a custom, built to order system for the store owner are limited. Scanpoint is a notable exception, since their solution consists of only the essential components. These components can be fitted into any piece of furniture the shop fitter wishes, ensuring great freedom in design for the shop fitter. More on this subject will be explained in section 1.3.

1.2.2 Requirements

The demand side of the market for checkout systems is rather complex. The requirements for a shop interior can come from various stakeholders. Of course, the owner of the store is an important decision maker. Also influential is the retail chain the store operates in, since those organisations often have strict requirements regarding the appearance of a store and the way customers are

treated. Another influential stakeholder can be the store manager, which in some cases is the same person as the store owner. In other cases, the retail chain is the owner of the store and as such can determine the requirements. These parties decide what they want and then approach a shop fitter to execute the project.

1.2.3 Checkout market diagram

The following graphical representation (Fig. 1) explains the relations between the various parties that are active in the market for checkout solutions.

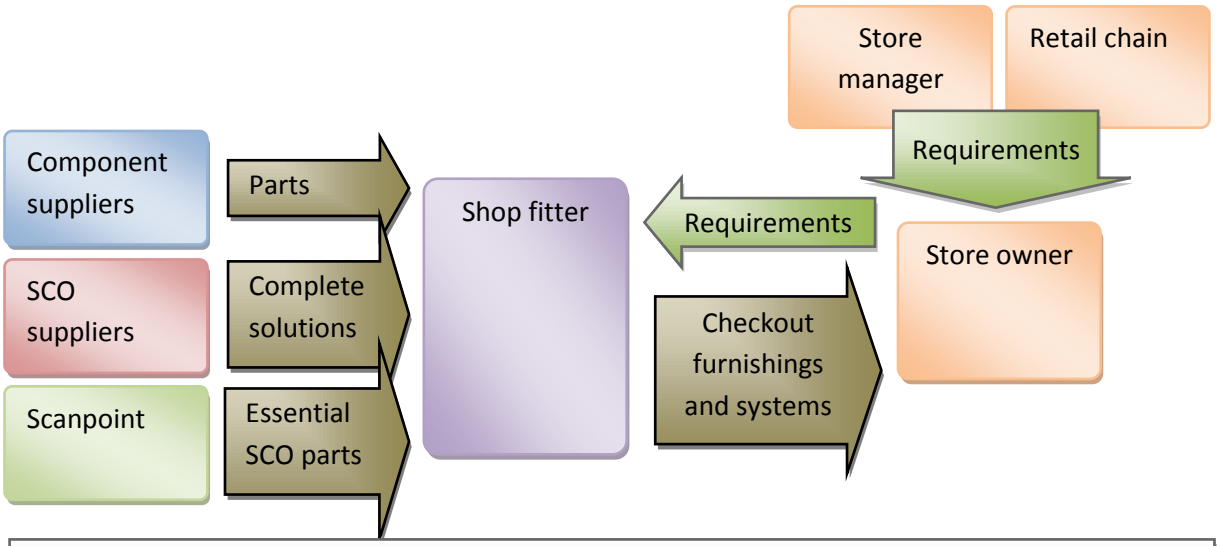


Fig. 1 – Parties and relations in the checkout market

1.3 What is the position of Scanpoint in the market?

1.3.1 Original Equipment Manufacturer

As described in section 1.2 and shown in Fig 1, Scanpoint has a unique market position for self checkout solutions. Scanpoint is a so-called Original Equipment Manufacturer, or OEM, which means that they provide the components necessary for their solutions to other parties. These parties in turn use the parts in the end product. In this case, the necessary components that Scanpoint delivers are electronics and software for self checkout systems. These components can be built into checkout furnishings by the shop fitter. This business model allows Scanpoint's solutions to be used in varying situations and under varying circumstances. This means the shop fitters can build furnishing for the self checkout that suits their customers' needs and that seamlessly integrates in the existing product lines. The position Scanpoint is in is unique, because no other supplier uses the OEM business model for self checkout solutions. The competitors deliver complete systems that allow for customisation to a small degree. The styling of these products and the arrangement of the components cannot be changed.

1.3.2 Customer support

Scanpoint also provides product support and services to the stores directly. Normally, the service and maintenance of checkout products is carried out by the shop fitter, but due to the complex nature of the self checkout solution not all issues can be resolved by the shop fitter and an expert helpdesk is needed. Scanpoint handles the issues and when necessary directs a technician to the store. Also, feature requests and solutions to unforeseen problems are handled by Scanpoint directly.

1.3.3 Scanpoint's offerings

Scanpoint offers a complete self checkout solution that consists of multiple separate systems that work together. The Scanpoint self checkout solution currently consists of two self checkout systems and three peripheral systems. These peripheral systems are needed to complete the self checkout solution. In this section follows a brief description of the various systems. A more in-depth description can be found in attachment A.

1.3.3.1 The Scanpoint self checkout solution

The self checkout solution provided by Scanpoint consists of two self checkout systems (Scanpoint Lite and Scanpoint XS) and three peripheral systems. At the self checkout systems, the customer can scan the groceries. After all groceries are registered by the computer, the receipt is finalised. The customer can pay at the self checkout with a bank card, or choose to pay the receipt in cash at a cash payment machine (Cashpoint) or at an attended service desk (Servicepoint). When the payment is done, the customer receives an exit receipt. This receipt can be scanned at the Exitpoint so that the gate opens and the customer can leave the store.

In attachment J, the Scangineers self checkout solution is illustrated by checkout manufacturer Itab.

1.3.3.2 Scanpoint Lite

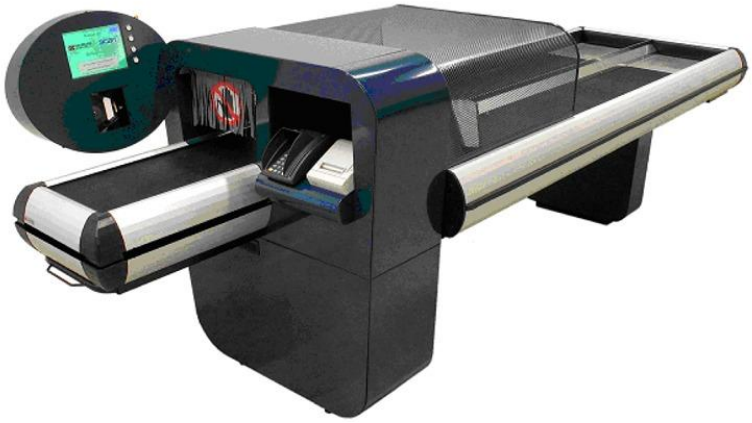


Fig. 2 Scanpoint Lite

Scanpoint Lite (Fig. 2) is a self checkout system with conveyor belts. This system can be used with smaller or larger quantities of groceries, because the conveyor belt transports the groceries to a packing area. The customer can elect to pay directly at the Scanpoint Lite with a bank card. The system is very well equipped for customers that use shopping carts. There are two parallel rear belts, which allow a customer to start scanning even if the previous customer is not yet done packing. This is the most popular self checkout system of the two systems currently in service; over 300 Scanpoint Lite systems are currently operational in stores. The hybrid checkout solution that is the goal of this project will be based on the Scanpoint Lite.

1.3.3.3 Scanpoint XS

Scanpoint XS (Fig. 3) is a scan-to-bag self checkout system which means that it allows the user to pack each scanned product directly in a bag or box. This is a difference with the Scanpoint Lite, where the users will scan all their products before they start packing them. The system is best suited for small quantities of groceries, most likely carried to the checkout in a shopping basket. The basket is put on a platform and the groceries can be scanned. The scanned products can be put directly in a plastic bag or cardboard box on the other side of the scanner. The customer can elect to pay directly at the Scanpoint XS with a bank card.

Fig. 3 Scanpoint XS

1.3.3.4 Cashpoint

The Cashpoint is a payment terminal that allows the customer to pay the groceries with coins or bank notes.

1.3.3.5 Servicepoint

The Servicepoint is a service desk for attendants. At this desk a supermarket employee can handle cash payments, but also bank card payments. The attendant can also monitor the self checkout systems, handle problems and answer questions.

1.3.3.6 Exitpoint and self checkout area

After passing the self checkout systems, the customer is guided into the self checkout area. This is a controlled area (usually surrounded by a fence) in which the Servicepoint and Cashpoint systems are situated. After the groceries are paid, the customer receives an exit receipt. The Exitpoint is located at the electronic gate of the self checkout area. At the Exitpoint, the customer can scan the exit receipt. The Exitpoint opens the gate if the receipt is indeed paid for.

1.3.3.7 Security

To prevent fraud at the checkout, the Scanpoint checkout systems have a few security measures in place. Both models have a weight scale that checks if the item on the belt or in the basket is the same as the item that was scanned by the customer. The system checks in a centrally stored database how much the scanned article weighs, and checks if this weight corresponds to the weight that was detected by the scale. On top of this, the Scanpoint Lite has a light curtain, internally referred to as the objectsensor, which registers if only scanned items are passing through the checkout to the packing area. This objectsensor is placed in a tunnel, which prevents that customers place or throw items past the objectsensor. The objectsensor and tunnel are a security feature that set the Scanpoint Lite apart from its direct competitors.

1.3.3.8 Age restricted products

In the supermarket, some products may only be sold to people above a certain age. As an example, in the Netherlands, alcoholic beverages and cigarettes may only be sold to people above 16 years old. The Scanpoint models have a built in warning system that alerts the attendant when an age restricted product is scanned, allowing the attendant to check the age of the customer. This warning

system works by sending an alert to the attendant's display at the Servicepoint, as well as by activating an orange light on the self checkout system.

1.4 Which products from other companies are competing with Scanpoint' products?

1.4.1 Two types of self checkout

Currently, two quite distinctive types of self checkout are available to shop fitters and store owners. The first type is most important for this research, as this is the type of self checkout Scanpoint offers in their self checkout solution. An explanation of this type of self checkout is already given in the previous paragraphs that explain Scanpoint position in the market. In summary, in this type of self checkout the customer can shop just like in a store with conventional checkout. At the checkout, however, the customer identifies the products to the cash register and pays for them without the aid of a supermarket attendant.

The second type of self checkout is performed during the shopping in the store. The customer picks up a scanning terminal (Fig. 4) at the entrance of the store and uses this to scan the products when they are put in the shopping cart or basket. At the checkout, the customer only has to return the scanning terminal, pay for the scanned items and leave. This type of self checkout will be called 'scan terminal self checkout' (or STSCO) in this report, to distinguish it from the first type which will be simply referred to as 'self checkout' (or SCO). The reason for this decision, apart from convenience, is that the shopping process for the first type is more akin to the conventional shopping process, and as such is more 'standard' and needs no additional describing words.

Fig. 4 Scan terminal for STSCO

The following table provides a basic comparison between the two types of self checkout:

	Type 1: Self checkout (SCO)	**Type 2: Scan terminal self checkout**
Before shopping	Nothing	Pick up scan terminal, register (with Customer loyalty card)
During shopping	Nothing	Scan products before putting them into cart
After shopping	Scan products, pay and leave	Return scanner, pay and leave
Difference from conventional shopping procedure	Small	Substantial: many extra actions required during shopping

Because Scanpoint is only active on the type 1 self checkout market, and it is not an option to select type 2 as a solution to the design problem of this project, the type 2 self checkout solutions will not be further investigated.

As part of the investigation into the checkout market, the Euroshop Retail Trade Fair in Düsseldorf, Germany was attended. A report of this visit can be found in attachment H.

1.4.2 Self checkout

Scanpoint' checkout solution is completely aimed at the self checkout market, and thus Scanpoint does not have to compete directly with suppliers of conventional checkouts. However, many of these suppliers have started developing self checkout systems, probably because they believe self checkout is the future of the checkout market and they want to remain active in that market. These companies are the direct competition of Scanpoint. Among these checkout suppliers are some of the biggest names in the industry, such as IBM, Wincor-Nixdorf, NCR and Fujitsu. In attachment B, an overview of the self checkout solutions offered by these companies is given. The websites of these companies that were used as a source of information to put this overview together are also given in this attachment. As a summary of the overview, two important facts can be concluded.

The first is that most SCO manufacturers are focussed on scan-to-bag systems. There are various configurations with support for one up to six bags at a single checkout station. Some manufacturers also offer systems with conveyor belts, like the Scanpoint Lite, but these are nothing more than scan-to-bag systems with a belt fitted before or after the scanning plate. In contrast, the Scanpoint Lite system by Scanpoint is completely designed around the belts.

The second important fact is that all other manufacturers provide all-in-one solutions. Their systems come complete with enclosures and there are very few options for shop fitters to customise the system or its appearance for a specific store. On the other hand, the solution offered by Scanpoint and its partners can be fitted in any checkout furnishing, as long as certain key components (such as the security weight scale and the light curtain) are installed correctly.

1.4.3 Hybrid self checkout

Generally, the solutions offered by the competitors are focused on self checkout and are not optimized to be used by a store attendant when necessary. Some competitors provide rather elaborate administrative functions in their software interface that allow a supermarket attendant to perform functions similar to those on a regular, conventional checkout. This can be very useful, because this way an attendant can help a customer at a self checkout system by scanning the products for him of her. This could lead to a faster checkout process. However, the shape and design of the system are not very useful for an attendant to service the customer, because the customer and the attendant face the same direction rather than are placed opposite from each other. This, in combination with the absence of a seat, could lead to more physical strain for the attendant. On the other hand, due to the fact that this is a software-only solution, this is a relatively cheap way to implement a hybrid checkout system, both in terms of hardware costs and precious store floor space. Therefore, a similar solution may or may not be the preferred solution for the Scanpoint hybrid system, depending on the relative importance of the various stakeholders' requirements.

For this project, one solution offered by a competitor is especially interesting. DigiPos, a German manufacturer of checkout products and systems, offers a hybrid checkout solution that could be very similar to the result of this project (Fig. 5). Their line of self checkout products is named The Utopia Solution, and the hybrid is only one of multiple self checkout solutions. Their hybrid solution is a self checkout system that can transform into an attended checkout in a few steps. Judging from footage shot at a trade fair [DigiPos, 2007], the actions necessary for this transformation are quite cumbersome. However, this system may be useful as inspiration for the design of a hybrid self checkout solution for Scanpoint.

Fig. 5 Digipos Utopia hybrid checkout system

1.5 Where will the subject of this project, a hybrid checkout system, fit in the market?

A hybrid solution is an often-heard request from shop fitters and store owners. The main reason they give is that a cashier can work faster than a customer using a self checkout system. Therefore, at busy times it could be beneficial for the store's efficiency to use a self checkout as an extra attended checkout to quickly help as many customers as possible.

A market survey has revealed that two different directions are possible to honour this request. The aforementioned DigiPos Utopia system shows one of these directions: a self checkout system that can physically transform into a checkout that is similar in appearance to a conventional attended checkout. The other direction is taken by some other suppliers of self checkout systems. This direction is a relatively simple addition to the systems user interface software that allows a store employee to help at a self checkout system. This direction does not provide the physical similarity to a conventional checkout, which might prove crucial to a hybrid solutions success.

The subject of this project, a hybrid checkout solution based on Scanpoint' self checkout system, will try to honour the request from shop fitters and store owners for such a system. As mentioned above, two solution directions are investigated by various competing parties on the market, but neither has proven the most successful or effective. Therefore, both directions are open for investigation. The requirements of the various stakeholders and their relative importance will have to determine in which direction the preferred solution may be found.

1.6 What are the current developments in the market?

1.6.1 RFID chips versus barcodes

Possibly the most obvious development in the market is the shift towards smart product tags. Small, cheap chips based on Radio Frequency Identification (RFID) technology are in development at numerous companies. These tags are aimed at replacing the currently widely applied barcodes on products, which are used for identification purposes. For instance, these barcodes are used in supermarkets to identify the products at the checkout, allowing for a quick processing of large

quantities of products. The downside to barcodes is that they have to be held before a barcode scanner and that they are easily damaged (for instance by wrinkling the material they are printed on), rendering the code unreadable.

RFID chips are small, cheap electronic chips that transmit a radio signal on a specific frequency. The chips, and the products they are attached to, can be identified by this frequency. The RFID chips can be read from a distance through other materials. This is a great advantage over barcodes. The downside of RFID is that the radio signals are continuously transmitted, which could be a breach of the customer's privacy. A more pressing issue is the costs of the chips, which is a very high compared to the costs of printing a barcode on a product or package. Generally it is expected that RFID chips will become less expensive in the future. However, the novelty of the technology and the relatively high costs have prevented the technology to break through as a mainstream product. In the current generation of supermarkets, the barcode is still the preferred type of product identification despite its shortcomings compared to RFID chips. Scanpoint's self checkout solutions are currently optimized for barcodes. Support for RFID may be incorporated in the future, but is currently not yet requested by the clients and thus not yet implemented in the hardware and software.

1.6.2 In-store merchandising

In-store merchandising is not a new phenomenon, but the means by which a store owner can raise customer awareness for specific products or services have increased in the past years. As flat panel display technologies have become more affordable, they are used more and more for in-store communication purposes (Fig. 6). This means that a store owner has more options to promote certain products, for instance with a slideshow, a television commercial or a spoken message that is presented on these television monitors. This trend could be used in the design of the checkout system, for instance by reserving an appropriate part of the furnishing to allow a flat panel display to be mounted for promotional purposes.

Fig. 6 Example of in-store merchandising stand

2 How are checkout systems being used?

2.1 What is the opinion of the primary users on the checkout systems?

2.1.1 User interviews

To determine what the various users think of the checkout systems, a series of interviews has been done. In these short interviews customers and personnel were asked to tell their opinion on regular attended checkouts, self checkouts and the idea of a hybrid checkout as proposed for this project. The questions were aimed at getting qualitative information about the appreciation for the various checkout systems and the different users of these systems. Due to the qualitative nature, 16

customers, seven staff members and one manager were interviewed. The results were used both to create the personas (see the next section) and to answer the questions in this chapter. A more thorough analysis of the interviews can be found in attachment L (in Dutch).

2.1.1.1 Interview locations

Two supermarkets that have Scanpoint self checkouts in operation allowed interviews with customers and staff members. One is a C1000 store in Bodegraven (The Netherlands), the other is a Hoogvliet store in Hilversum (The Netherlands). Important differences between the two stores concern the payment options and service attendants. The differences are given in the following descriptions of these stores.

2.1.1.1.1 C1000 Langerak Raadhuisplein, Bodegraven

The C1000 store Langerak Raadhuisplein in Bodegraven is the store that participated in the first pilot of Scanpoint self checkout systems, and has been operating these systems ever since. The self checkouts had various problems due to the new technology when they were first deployed, but are currently working well and both customers and staff members are very positive about them. At this store there were a Cashpoint cash payment terminal and a Servicepoint. Both of these allow the customers to pay with cash, rather than with a bank card at the checkout. At any time there was one attendant present to service just the self checkout customers. There were six self checkout systems of the Scanpoint Lite type, positioned three by three with one path in between.

2.1.1.1.2 Hoogvliet Seinstraat, Hilversum

The other store that allowed the interviews was Hoogvliet Seinstraat in Hilversum, a store that only recently started using self checkouts. This was very obvious, because both staff members and customers were less satisfied with the system. In this store, customers could only pay with bank cards when they chose to use self checkout and there was not a special service desk at which an attendant was present to help customers. When a customer or system required attention, an employee had to come from another position, for instance the general service desk of the store. There were four Scanpoint Lite systems with two paths (in the following order: one SPL, path, two SPLs, path, one SPL).

2.1.1.2 Satisfaction with the various systems

As mentioned above, the two stores were rather different in the way the self checkout systems were implemented. Also, the customers and personnel of the Hoogvliet supermarket were clearly not yet accustomed to the system, contrary to the C1000 where the systems were widely accepted and appreciated. This is also the most important conclusion of the interviews: it takes time for the systems to be accepted and appreciated. Customers often make beginners mistakes with the systems, and it takes time and effort from the store employees to help the customers get accustomed to this new way to check out their groceries.

2.1.1.3 Perceived bottlenecks and annoyances

The questions during the interviews were partially aimed at understanding what customers like and dislike about the various checkout systems. The following bottlenecks and annoyances were the most relevant for this project. Some of the other points made by the interviewees were issues with the specific implementation in their store, while others were issues with the Scanpoint system in general that cannot be changed for this project.

Bottleneck/annoyance	Staff	Customer
Conventional, attended checkouts		
Bad seats that cannot be adjusted to personal preferences	✓	
Long queues, long waiting time		✓
Self checkouts		
Too little room for groceries on the pick-up belt (after checkout)	✓	✓
Indication for alcoholic products is not clear enough	✓	
Only payment with bank cards (depending on store)		✓
When paying with cash: having to go to two separate stations, wait twice in line		✓

2.1.1.4 Suggestions for checkout systems

Suggestions	Staff	Customer	Manager
Conventional, attended checkouts			
High quality, adjustable chairs	✓		
Adjustable foot rest	✓		
Room for movement in cashiers cabin (roll chair, pick up dropped items, leg space, etc)	✓		
Touch screen rather than keyboard system	✓		
Quick checkout, no unnecessary waiting, short queues		✓	
Personal contact with the cashier is an important aspect		✓	
Plenty of space for groceries on the pick-up belt	✓	✓	
Self checkouts			
Plenty of space for groceries on the pick-up belt	✓	✓	
Allow barcode numbers to be entered manually (useful when barcode is damaged or otherwise unreadable)	✓		
Less height difference between belts (prevent products from falling and bumping)	✓		
Clear indicator when alcoholic products are purchased	✓		
Privacy for both cashiers and customers (especially when dealing with money, bank transactions, etc)	✓	✓	
Clear view on the checkout systems and area from service desk (both via Servicepoint monitor and visually in the store)	✓		
Clear explanation of the intended use (presented on signs or explained by a service attendant)	✓	✓	
Cash payment should always be an option		✓	
Easy to understand, easy to use (usability should be a high priority, both in the design of the overall system as in the design of the user interface)	✓	✓	✓
Hybrid checkout *(most suggestions for other checkouts apply as well)*			
When in attended mode: allow cashier to perform the same tasks as at a regular checkout; when in SCO mode: work like a regular self checkout system.	✓	✓	

Attended mode: cashier wants to sit	✓		
Meet the same requirements as the separate checkouts that are combined in the hybrid checkout	✓	✓	
Mode (attended or self checkout) must be very obvious to the customer (presence of cashier must be visible, mode changes must be clearly communicated)	✓	✓	
The footprint of the system must be kept to a minimum (floor space is valuable)			✓
Prevent damage to groceries (for instance by product separator arm)	✓		✓

2.2 Who are the primary users of checkout systems during daily operation?

An overview of the primary users of checkout systems is relatively easy to compose. A simple observation and interview in a supermarket reveals that there are two parties that use the checkouts: the supermarket staff, and the customers. Both parties can be further divided into different categories. Customers for instance can be further divided into different usage characteristics that may be dependent on factors like age, experience, lifestyle, interests and other personal preferences. The staff that uses the checkouts can be divided into categories as well. This can be done by looking at the various functions a staff member can perform within a supermarket, such as cashier or principal cashier. However, for some functions there may be different types of users within that group, so a further division into types of users may be required. Just as with customers, staff members may be categorized based on age, experience, personal preferences, etcetera. In the following section, an attempt is made to catch all these different categories of users in so-called personas.

2.2.1 About personas

Personas are fictional persons whose experience, preferences and other usage characteristics are representative for a broad group of real-world users. Important aspect when creating personas is to give them a name, a fictional biography that makes them appear as a real person and specific demands towards the product. When the personas are created carefully, they can be a powerful tool when specific design decisions must be made. For instance, the decision to design for one persona but not for the other might make it easier to decide which functions to implement and which functions to discard. For instance, John is one persona and Jane another. The decision was made to design for Jane, and not for John. If a certain function is very important to John, but Jane doesn't need it, it should not have a priority. Rather, the designer should focus on the functions that are important to Jane. [Cooper, 1999]

Several personas have been created for the hybrid checkout system that is the subject of this research project. In the following paragraph, the global characteristics of these personas are explained. These personas could then be used in the design phase, which is described in chapter 4 of this report, to make design decisions.

2.2.2 Personas

When creating the personas, at first an attempt was made to globally describe as many separate types of users as possible. Then, by critically looking at the properties of these personas with respect

to their checkout habits and preferences, the personas that were similar were merged into a new, single persona. Eventually, seven different personas were created. Four of these personas are customers; Gerrit (76), Jacques (29), Marianne (39) and Tim (7). Two of the personas are supermarket employees; Debby (48) and Lisa (32). Finally, the last persona is a technician named Freddy (28). Biographies for these personas may be found in attachment I. It is recommended that these biographies are read so that the reader is familiar with the personas and better understands the following discussion.

To effectively design a complex product, the critical persona must be determined. This critical persona is the one that needs to be able to successfully use the product, but is the most demanding in terms of requirements. In the case of the hybrid checkout system, the critical persona is Marianne, because she needs to be able to use the system, and wants to, but has the least experience and interest in technical products. While Gerrit is even less experienced and interested, he was not chosen as the critical persona. Because of his behaviour and preferences, it is very hard to design a system that would persuade Gerrit to use it. For this project, it was deemed too difficult and would provide too little benefits. It is chosen to not design the system for Gerrit, but rather for a persona that is less hard to cater and more likely to eventually use the system. In this case, this was Marianne. Jacques is more interested in technology and has more experience with technical products, and therefore will be able to use the system if Marianne is able to. It is not necessary to focus on Jacques during the design of the system. Tim, the persona that is still a child, is not an autonomous user of the system but is always assisted while using it. Therefore, it is not needed to design for Tim specifically but rather for the person that accompanies him, who will either be able to use the system if Marianne is able to, or will choose not to use the system like Gerrit.

The other three personas, Debby, the cashier, Lisa, the principal cashier, and Freddy, the technician, all will be users of the system and it is not an option to choose to not design for them. Their requirements towards the system, however, are mostly separable from those of the customer personas. Therefore, it is possible to design for both the critical persona, Marianne, and for these three personas.

2.3 Which tasks are performed during the various checkout processes?

2.3.1 Conventional checkout

Conventional checkout means that the checkout is performed by a supermarket attendant. This process is slightly different at various supermarkets. To get a general understanding of the process, various supermarkets were studied. The results are used to make a general task analysis for this type of checkout which is given in the tables in the following sections. The columns separate the cashier's actions from the customer's actions, and the rows indicate that some actions happen more or less at the same time. Not all actions are mandatory; these are marked as optional (opt.).

2.3.1.1 Super de Boer

Cashier	*Customer*
	Place groceries on front belt
(Greet customer)	(Greet cashier)
Ask for customer loyalty card	Give customer loyalty card (opt.)
Put customer loyalty card in	

reader (opt.)	
Scanning of products, vouchers, money refund receipts, etc.	Hand over additional vouchers, money refund receipts, etc. (opt.)
Check age if customer wishes age restricted products (opt.)	Tell age or show identification (opt.)
Ask if customer wants purchase stamps	Choose purchase stamps yes or no
Calculate total	
Allow payment (Cash or PIN)	Pay with cash or using PIN terminal
Hand out stamps (opt.)	Receive stamps (opt.)
Return customer loyalty card	Receive customer loyalty card
Hand over receipt	Receive receipt
(Greet customer)	(Greet cashier)
	Pack groceries (from rear belt)

Most important observations:

1. Customer loyalty card is read before all other actions performed by cashier
2. Customer loyalty card is returned after all other actions performed by cashier, except returning of the receipt (which is the final step for the cashier)
3. Customer loyalty card is not mandatory to receive price reduction for action products, it does facilitate an extra point saving system called ROCKS.

2.3.1.2 Albert Heijn, Hoogvliet

Cashier	***Customer***
	Place groceries on front belt
(Greet customer)	(Greet cashier)
Scanning of products, vouchers, money refund receipts, customer loyalty card, etc.	Hand over additional vouchers, money refund receipts, customer loyalty card, etc. (opt.)
Check age if customer wishes age restricted products (opt.)	Tell age or show identification (opt.)
Ask for CUSTOMER LOYALTY CARD (opt.)	Give customer loyalty card (opt.)
Scan customer loyalty card (opt.)	
Return customer loyalty card	Receive v
Calculate total	
Allow payment (Cash or PIN)	Pay with cash or using PIN terminal
Hand over receipt	Receive receipt
(Greet customer)	(Greet cashier)
(Greet next customer)	Pack groceries (from rear belt)

Most important observations:

1. Customer loyalty card can be scanned at any moment during the checkout process.

2. Customer loyalty card is mandatory to receive the price reduction for action products (action is called 'Bonus'; customer loyalty card is called 'Bonuskaart' ('Bonus Card').
3. Air Miles is a separate saving plan available at AH; customer loyalty card may be linked to an Air Miles card.

2.3.1.3 General

For the general task analysis the situation at Albert Heijn and Hoogvliet is copied. This is because this is the system for the customer loyalty card that is used in most supermarkets. Also, this is the customer loyalty card system that is supported by the current self checkout solutions from Scanpoint.

Cashier	***Customer***
	Place groceries on front belt
(Greet customer)	(Greet cashier)
Scanning of products, vouchers, money refund receipts, customer loyalty card, etc.	Hand over additional vouchers, money refund receipts, customer loyalty card, etc. (opt.)
Check age if customer wishes age restricted products (opt.)	Tell age or show identification (opt.)
Ask for customer loyalty card (opt.)	Give customer loyalty card (opt.)
Scan customer loyalty card (opt.)	
Return customer loyalty card	Receive customer loyalty card
Calculate total	
Allow payment (Cash or PIN)	Pay with cash or using PIN terminal
Hand over receipt	Receive receipt
(Greet customer)	(Greet cashier)
(Greet next customer)	Pack groceries (from rear belt)

Important properties:

1. The customer loyalty card may be scanned at any point during the checkout procedure before the receipt is finalized.

2.3.2 Self Checkout (Scanpoint Lite)

The following task analysis for the Scanpoint Lite self checkout system was made in the test facility at Scanpoint. The result was compared with the observations of the self checkout systems at the supermarkets where the user interviews were done. (See Table 1 on the next page.)

<table>
<tr><td colspan="3">Customer</td></tr>
<tr><td colspan="2">Scan customer loyalty card</td><td></td></tr>
<tr><td colspan="2">Scan product</td><td rowspan="3">Repeat for all products</td></tr>
<tr><td colspan="2">Place product on weighing belt</td></tr>
<tr><td colspan="2">Alert service attendant if age restricted product is scanned</td></tr>
<tr><td colspan="3">Scan refund receipt (opt.)</td></tr>
<tr><td colspan="3">Choose Stop</td></tr>
<tr><td colspan="3">Choose payment method (Cash or PIN)</td></tr>
<tr><td>PIN:</td><td colspan="2">Cash (only if Servicepoint and/or Cashpoint is available):</td></tr>
<tr><td>Pay using PIN terminal</td><td colspan="2">Receive intermediate payment receipt</td></tr>
<tr><td>Receive exit receipt</td><td colspan="2">Pack products in bags/boxes/etc. at the rear belt</td></tr>
<tr><td>Pack products in bags/boxes/etc. at the rear belt</td><td colspan="2">Choose Servicepoint or Cashpoint (not available in all stores)</td></tr>
<tr><td></td><td>Servicepoint:</td><td>Cashpoint:</td></tr>
<tr><td></td><td>Go to Servicepoint</td><td>Go to Cashpoint</td></tr>
<tr><td></td><td>Give intermediate payment receipt</td><td>Scan intermediate payment receipt</td></tr>
<tr><td></td><td>Pay attendant, receive change</td><td>Insert cash money (coins and bills) in Cashpoint, receive change</td></tr>
<tr><td></td><td colspan="2">Receive exit receipt</td></tr>
<tr><td colspan="3">Go to Exitpoint near the exit gate of the SCO area</td></tr>
<tr><td colspan="3">Scan exit receipt at Exitpoint (exit gate will open)</td></tr>
<tr><td colspan="3">Exit SCO area</td></tr>
</table>

Table 1. Task analysis for a Scanpoint Lite self checkout system

2.3.3 Hybrid checkout

For hybrid checkout, the tasks depend on what functionality is required by the stakeholders. A very important outcome of the user interviews is that both supermarket staff and customers expect the functionality of a hybrid checkout to be the same as the functionality of a regular checkout (when in attended checkout mode) and the same as a self checkout (when in self checkout mode). This requirement will be used in the requirement analysis later in this report. Assuming this requirement will be met, the task analysis for a hybrid checkout system will be very similar to the task analysis for conventional or self checkout systems, depending on the mode of operation. These task analyses may be found in the previous sections of this paragraph.

The mode switching procedure is the procedure that has to be followed in order to switch the hybrid checkout between attended and self checkout modes. A task analysis for this mode switching procedure could be useful, but is probably very different for the various hybrid checkout concepts that will be drafted. Therefore, such an analysis cannot be made before the concepts are created. At that point, a task analysis may be a useful tool to evaluate the performance of the various concepts. Whether or not these analyses will be done, will be decided when the final concepts are selected. More on the selection of these concepts can be found in chapter 4.

3 What are the requirements that need to be met by a hybrid checkout system?

3.1 Who are the stakeholders for checkout systems?

The stakeholders for checkout systems are all parties that, in one way or another, have an interest in the functioning of the system. The most obvious stakeholders for any product are its users. In the case of a checkout system, the users may be divided into customers, attendants, technical maintenance workers and cleaners. Besides the users, there are quite a few other parties that have an interest in how the system works. For instance, the store owner may have specific wishes for the system, despite the fact that he or she will not be a direct user. Also important are the requirements for the checkouts that are issued by the retail chain in which a store operates. Last but not least, the parties that cooperate to design and build the checkout system also have specific demands for the design of the system. All these stakeholders and their requirements will be discussed in the rest of this section.

3.1.1 User stakeholders

3.1.1.1 Customer

The customers of the supermarket are a very varied group of people because it contains people from all layers and backgrounds of society. Due to the varied nature of these users, in section 2.2 this group was divided into different user personas. These personas have in turn been used to determine some of the requirements that the customers have regarding checkout systems presented later on in this chapter. The requirements of this group are versatile, since this is the only group of users that has to work with the checkout functions of the system in both modes. Other requirements from this group of users were found during the user interviews.

The requirements of this group of users are mostly related to the ease of use of the checkout system and the level of service provided by it.

3.1.1.2 Attendant

The attendants are supermarket staff members that assist the customers during the checkout of the groceries. In the attended checkout mode they function as a cashier, checking out all desired products and facilitating the payment. In the self checkout mode, an attendant is still required to help customers when they encounter problems when using the self checkout systems. Also, depending on the implementation of self checkout in a particular store, the attendants at a service desk facilitate cash payment for customers who have used a self checkout system to register the products, but do not wish to pay with a bank card. It is also the attendant's job to ensure that age restricted products, such as alcoholic beverages and cigarettes, are not sold to people below the restricted age. This is a difficult job, especially for younger attendants that may be quickly intimidated or are very sensitive to social pressure.

The requirements for checkout systems from this group are related to the ease of use of the system. Ease of use for attendants is not only determined by how easy to understand and operate the system is, but also how comfortable it is to work at the checkout. The attendant performs the same tasks for hours on end, which easily results in work related injuries. The attendants require the system to be comfortable and safe to use to minimize these injuries. It is important that the checkout allows the attendant to check the age of customers that want to purchase age restricted products, regardless of what mode the system operates in.

3.1.1.3 Technical maintenance worker

The technical maintenance workers are primarily the people that service and maintain the checkout systems, especially when the system does not function properly. However, during the building and installing of the system the technical staff may also have some specific demands to the system. All technical workers during the various product life phases are grouped in this stakeholder category.

The requirements they have regarding the checkout system are all related to easy and safe access to the various parts of the system, either to install them for the first time or to repair or replace them during usage.

3.1.1.4 Cleaner

In most supermarkets, cleaning is done by the attendants when there are more attendants than are needed to help all customers. The requirements regarding the cleaning of the system are different from those regarding the use of the system, and therefore the cleaners are chosen as a separate user group.

The requirements of cleaners are all related to the cleaning of the system and the surrounding store parts, such as the floor.

3.1.2 Non-user stakeholders

3.1.2.1 Supervising cashier

In most situations, there is one supermarket attendant who is in charge of the checkout area. This attendant usually works at the service counter of the store and is the primary person for customers and other checkout attendants to turn to when there is a problem. Also, small but expensive items (such as cigarettes and razor blades) are sold the service counter. The supervising attendant usually takes care of these sales. The supervising attendant is also in charge of money transactions between the store's vault (usually located in a nearby office) and the various cash drawers that are in use by the other attendants at the checkouts. Another important role for the supervising cashier is to manage the other cashiers to make sure they work efficiently and perform as they are supposed to. Generally, the person who acts as supervising cashier does not work at a regular checkout, and therefore is not a direct user of a hybrid checkout system.

The requirements of the supervising attendant are more related to the effective employment of other attendants at the various checkout systems. For the supervising attendant it is also important to minimize errors during the checkout, as the supervising attendant is the one who has to solve these errors. Generally, the supervising attendant is more aware of the need to provide good customer service than the regular cashiers.

3.1.2.2 Store manager

This stakeholder is the person in charge of the store and ultimately the one who is responsible for the store performance. Sometimes, the store manager is also the owner. In other cases, the store is owned by someone else or owned by the retail chain it operates in. The manager is concerned with keeping store operating costs down, while keeping the sales up. To keep costs down, it is important that employees are deployed effectively. The store manager tries to keep the customers satisfied to make sure they come back and generate turnover.

The requirements of the store manager are mostly aimed at allowing the employees to perform effectively and efficiently, while providing the customer with the expected service.

3.1.2.3 Retail chain management

A retail chain is a chain of stores that operates under the same name and with the same identity. One of the goals of the management of such a chain is to maintain a uniform identity for all stores in the chain. The customer experience should be the same in all stores, and should be in accordance with the intended experience for the retail chain.

The requirements set by the retail chain management are aimed at maintaining a uniform customer experience and store identity throughout all the affiliated stores.

3.1.2.4 Shop fitter / furniture manufacturer

The shop fitter is often also the designer and manufacturer of the store furniture. The goal for the shop fitter is to furnish as many stores as possible. The clients are the store owners, and an obvious strategy to sell more store furniture is to meet the client's demands as good as possible. To create and maintain a good reputation, it is important to be recognized. This can be achieved by differentiating the furniture designs from those of the competitors.

The requirements from shop fitters are aimed at meeting their clients' demands, while maintaining a recognizable company identity.

3.1.2.5 Scanpoint

Scanpoint has, very much like the shop fitters, an interest in selling as much self checkout systems as possible. This can be achieved in the same way, too, so the requirements for Scanpoint are not very different from those of the shop fitters. Scanpoint is a small company with limited resources, and as such has to use existing technology as effectively as possible.

The company has an interest in the effective re-using of existing technology to keep the development costs of a new self checkout system low.

3.2 Which functions must be served by the hybrid checkout system?

The following functions must be performed by the hybrid checkout system. The functions are only related to the actual checkout product. Functions that are required for this checkout to function, but that are performed by other systems in the operating environment, such as the checkout server, service desk, cash payment machines or the exit gate, are not specified in this document. The functions are primarily grouped by function type as introduced in Productontwerpen [Eger et al., 2004, p74].

3.2.1 General functions

1. Feature an attended mode and a self checkout mode
2. Communicate current mode
3. Communicate mode changes

3.2.2 Usage functions

3.2.2.1 Checkout functions

4. Feature a front belt with weighing unit
5. Feature an objectsensor (light curtain)
6. Allow registration of checked out supermarket products

    a. Scan barcodes of checked out products
        i. By attendant in attended mode
        ii. By customer in self checkout mode
    b. Allow extra actions, manual barcode entry, cancelling of products, etcetera
    c. Provide link with POS system
    d. Calculate total due amount
7. Accept refund tickets/coupons/etcetera (barcode mandatory)
8. Allow services connected to customer loyalty card
9. Allow payment for checked out supermarket products
    a. Allow cash payment in attended mode[1]
    b. Allow bank card payment in both modes
10. Print receipts
    a. Accessible for attendant in attended mode (unless a digital copy of the receipt is displayed on a feedback device that is visible for the attendant, and allows the attendant to look at the entire receipt from top to bottom, in which case the receipt printer may be placed so that it is only accessible for the customer)
    b. Accessible for customer in self checkout mode
11. Feature cash drawer similar to those found in conventional checkouts
12. Plus: provide room for bank note deposit box

3.2.2.2 Physical functions

13. Provide room for products
    a. In attended mode: before scanning (product queue)
    b. In both modes: after scanning (packing area)
    c. For two customers, with average amounts of groceries, at a time
14. Provide means to physically separate products of subsequent customers in attended mode
15. Plus: provide means to automatically separate products of subsequent customers in self checkout mode

3.2.2.3 Interface functions

16. Communicate checkout mode
17. Communicate checkout mode changes
18. Plus: support user by highlighting important locations on the checkout
19. Provide user interface
    a. Provide checkout information to customer in both modes
    b. Provide checkout and system information to attendant in attended mode
    c. Allow information input by attendant in attended mode
    d. Allow information input by customer in self checkout mode
    e. Allow administration access by service attendant in self checkout mode
    f. Plus: allow attendant to manually enter a barcode number in self checkout mode
    g. Plus: allow customer to manually enter a barcode number in self checkout mode
20. Display the occurrence of an error on the system
21. Warn attendants when an age restricted product is purchased in self checkout mode.

3.2.2.4 User interaction functions

22. Provide customer privacy when using bank cards as a payment method
23. Plus: keep cash drawer contents private from customers

3.2.2.5 Emotional functions

24. Communicate desired company image

[1] The decision to provide cash payment at the checkout only when in attended mode was made to make the user experience of the self checkout at a hybrid lane similar to that of a self checkout only lane. The Scanpoint self checkout solution allows for cash payment at cash payment terminals or at an attended service desk.

3.2.3 Support functions

25. Allow maintenance worker to access and replace internal parts
26. Allow cleaner access to places that become dirty during normal operation
27. Minimize potential places for dirt and dust to accumulate

3.3 Which requirements for Hybrid Checkout systems are set by Dutch Arbo law?

The Arbo law (Arbo is short for 'Arbeidsomstandigheden' or Work Circumstances) is a Dutch law aimed at protecting good working circumstances for employees. The 'Arbeidsomstandighedenbesluit' [SZW, 2008] (Working Circumstances Plan) is derived from the Arbo law and sets more concrete guidelines to the working conditions. However, these guidelines are still very general and are not aimed at specific branches. For this project, the Arbo law and the Arbeidsomstandighedenbesluit were checked for requirements that apply to checkout systems.[2] Because these documents are not written with just the retail environment in mind, the rules and guidelines cannot be translated in concrete requirements. The general rule, however, is that the working circumstances should be so that the employee can do the job without risks to the health and safety.

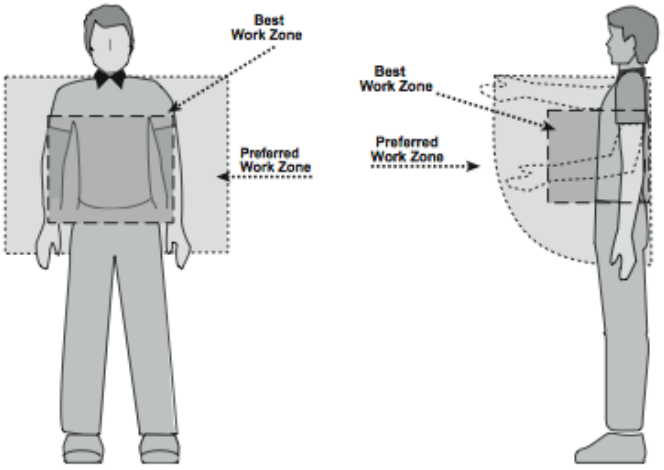


Fig. 7 Best work zone and Preferred work zone as described by OSHA

In a checkout environment, this means that the checkout furniture should allow the attendant to work in a healthy pose that does not strain the body in a harmful way. As a result, the design of the Hybrid Checkout system should be based on human factors such as measured body lengths and similar data. Productontwerpen [Eger et al., 2004] features some of the required data and can be used to determine the requirements for the different stakeholders. Guidelines for supermarket interior design aimed at reducing work strain for the employee, issued by the American Occupational Safety & Health Administration [OSHA, 2004], provided additional information about which human factors are most relevant for this project. The concept of a Best Work Zone and a Preferred Work Zone (Fig. 7) may be applied when designing the checkout system for this project. This results in some health and safety related requirements, which are used in section 3.4.

[2] It is assumed that other countries in which Scanpoint technology is applied have similar rules and laws. It is up to local shopfitters to apply local laws in the custom design.

3.4 What are the requirements for a hybrid checkout system?

All requirements are mandatory, with the exception of those marked Plus. The requirements marked Plus are not mandatory, but when met they provide added value to the system in terms of cost-effectiveness, usability or functionality.

The requirements are primarily grouped by the phase of the product life cycle they are related to, as described in Productontwerpen [Eger et al., 2004, p49].

3.4.1 Usage phase

3.4.1.1 User interaction requirements

1. The system must allow the customer and attendant to have a direct line of sight to each other.
2. The system must allow the customer and attendant to talk to each other directly, without altering the tone or the volume of the speech in any way.
3. The system must place the attendants and the customers in such a way that 95% of the attendants can give small items to or receive small items from 95% of the customers.

3.4.1.2 Security requirements

4. The cash drawer must be securely attached to the system, regardless of the current operating mode, to provide the same level of security as cash drawers in regular checkouts provide.
5. The optional bank note deposit box must be securely attached to the system, regardless of the current operating mode, to provide the same level of security as bank note deposit box in regular checkouts provide.

3.4.1.3 Mode switching requirements

6. Switch between attended mode and self checkout mode (and vice versa) in 30 seconds or less.
7. 95% of all supermarket staff members have to be mentally and physically able to perform a mode switch after they have had a proper explanation of the system.

3.4.1.4 Dimensional requirements

8. The maximum footprint of a hybrid checkout system is 100% of the footprint of a regular attended checkout. The largest attended checkouts have a footprint of 430 by 125 centimetres.
9. The checkout must be placed in the store with a wide enough aisle for a customer pushing a shopping cart to walk through.
10. Allow 95% of the customers to access the goods that are located on the front and rear belts.

3.4.1.5 Health and safety requirements

11. Do not harm users during operation, after operation or when passing by
12. Compliant to local health and safety laws (for this project: Dutch ARBO law, see section 3.3)
    a. Prevent strains and other injuries that are caused by performing repetitive actions with the system.
    b. Allow all primary actions[3] of the attendant to be performed in Preferred Work Zone[4]

[3] Primary actions are the actions that are performed repeatedly during the checkout process, such as scanning products, inputting data in the cash register, etc.

[4] The Preferred Work Zone is one of two zones in which a person's actions are performed most effectively and safely. The other zone is the Best Work Zone, which is more favorable but has smaller dimensions.[OSHA, 2005]

c. Plus: Allow all primary actions of the attendant to be performed in the Best Work Zone

3.4.1.6 Mode switching requirements

13. A mode switch has to be possible without requiring the customer and/or his/her shopping cart to move (the area that is accessible to them should not change).
14. A mode switch has to be possible without the removal of the products that are already on the front and rear belts.
15. The cash drawer must remain securely attached to the system during a mode switch.
16. The optional bank note deposit box must remain securely attached to the system during a mode switch.

3.5 What are the guidelines for a hybrid checkout system?

In this section, specific guidelines for the design of the hybrid checkout system are gathered. These guidelines do not fit in the section that covers the system functions because they are not specific functions the system has to perform. They do not fit in the requirements section either, because it cannot be specified to what extent these guidelines have to be met to achieve the project goals and end up with an acceptable end result. These guidelines are meant to direct the design in a specific direction by stating goals that should be pursued, but that cannot be set in a way that allows an objective evaluation of the achievement. The guidelines are primarily grouped by the phase of the product life cycle they are related to. The product life phases are taken from Productontwerpen [Eger et al., 2004, p49].

3.5.1 Design phase

1. Use existing components and software from current Scanpoint solutions
2. Use standard checkout components whenever possible

3.5.2 Production phase

3. Produced with techniques suitable for small production series

3.5.3 Distribution phase

4. Plus: transport in separate parts
5. Plus: easy assembly

3.5.4 Usage phase

3.5.4.1 Checkout guidelines

6. Provide a user experience similar to a conventional, attended checkout when in attended mode.
7. Provide a user experience similar to a self checkout when in self checkout mode.

3.5.4.2 Security guidelines

8. In self checkout mode, the system must prevent the customer from circumventing the scanning and registration process.

3.5.4.3 Emotional guidelines

9. The three concepts must be styled after three chosen photo collages, with an emphasis on chosen materials, material finish, colours and atmosphere.

3.5.4.4 Durability guidelines

10. Lifetime comparable to regular checkout and self checkout systems; because of the nature of this requirement, this study cannot be used to determine whether or not this requirement has been met.

3.5.4.5 Health and safety guidelines

11. Design two mirrored varieties to evenly balance body strain

3.5.5 Removal phase

12. Recycled in the same manner as checkout solutions currently in service

4 How should a hybrid checkout system look?

In this chapter is systematically determined how a hybrid checkout system that has the previously determined functions and meets the previously determined requirements and guidelines can be designed.

4.1 What components are mandatory for a hybrid checkout system to perform as required?

There are certain hardware components that any hybrid checkout system that meets the requirements and performs the required functions must include. A full list of these items is given in attachment C. This list is determined by investigating the parts list for a regular attended checkout and the parts list for a self checkout system. These part lists were then compared to determine the parts list for a hybrid checkout system.

An important decision for making the parts list is that the hybrid checkout system that will be designed, will be of the same type as the DigiPos system as described in section 1.5 and 1.6. Due to the requirements found in chapter 3, it is not an option to just add an elaborate attendant interface to the existing self checkout systems. The health and safety requirements imply that the attendant must have a comfortable and well designed checkout to work at. Also an important factor in this decision is the guideline that the system should behave similar to an existing self checkout in self checkout mode, and similar to an attended checkout in attended mode. This is not possible with just the addition of a software interface to the existing model, and therefore the hybrid checkout that will be designed will have a fully functional attendant workplace, as well as the necessary components to be a fully functional self checkout system.

On the parts list are, among other things, computer screens and interface elements for the cash register and conveyor belts to transport the goods. Also on this list are items that are specifically needed to make the self checkout system work, such as a weighing unit fitted in the front belt and an objectsensor, which is the light curtain that detects if a scanned and weighed item is transported from the front belt onto the next.

The number of needed parts that is displayed in the list after each part is the bare minimum, and it is not unthinkable that more than the given number of items of a part are used. As an example, the system needs a barcode scanner and a display screen with touch input in both modes. However, in attended mode these two items must face the attendant, whereas they must face the customer in self checkout mode. It is possible to design the system so that these parts are relocated during a mode switch. This probably makes the switching between modes more complex, adding design costs and probably higher costs for the mechanical system. Also, the extra action during a mode switch might cause the switch to take up more time than the maximum time as specified in the requirements. Considerations like these can lead to the decision to put each of the mentioned parts twice in the system, making the mode switching less complex but adding costs for the double components.

4.2 What are the optimal physical arrangements of these components?

In order to determine how the required parts can be combined to form a working hybrid system, a study towards the physical arrangements was done. This study consisted of the creation of foam

blocks that are shaped like the mentioned parts and are built to the same scale. These parts were then fitted together with small rods to create very rough scale models with different arrangements. Every model was created with the functions, requirements and guidelines, mentioned in the previous chapter, in mind. For examples of these models, see Fig. 8.

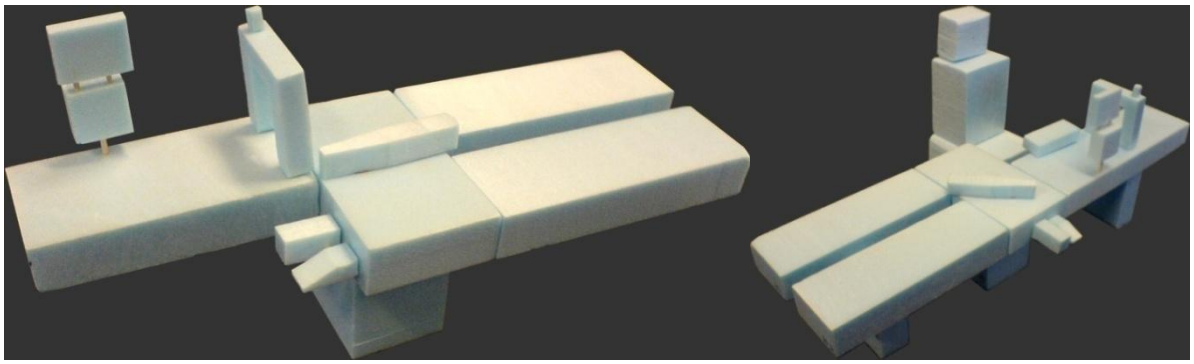


Fig. 8 Examples of two of the models

4.2.1 Results of the physical arrangement study

The result of this little experiment is a better understanding of the various parts and the way they have to be combined to make a system that works as intended. A very important observation is the importance of three specific requirements and guidelines. The first of these is the guideline that the user experience of the system in a certain mode should always be very much like the user experience of the existing checkout that performs that modes function. This guideline has proven to be a deciding factor in the forming of the various concepts. The second requirement that is very important is the requirement that limits the hybrid system's footprint to 100% of the footprint of a regular attended checkout. This requirement makes it necessary to exchange parts and choose important functions, rather than just add extra functionality at the cost of a larger footprint. As an example, when a specific area is added to a self checkout system for the attendant to work at, the space required for this area must be taken from other functions, for instance by shortening the length of the rear conveyor belts and thus limiting the storage capacity for products on these belts. The third requirement that is very determining for the possible concepts is the requirement that protects the well-being of the attendant. This requirement determines the direction of the attendant's workflow, the placement of key parts the attendant needs to operate and the position of the customer compared to the attendant.

The importance of these three guidelines and requirements and the consequences they impose on the concepts were understood through the experiment with the foam blocks.

4.2.2 Zone model: three functional zones

The result of the study of the possible physical arrangements is the forming of two models for the system (one for each checkout mode). Each of the models has three zones with specific functions that need to be performed in this zone. The models of these zones for each checkout mode are given in Fig. 9.

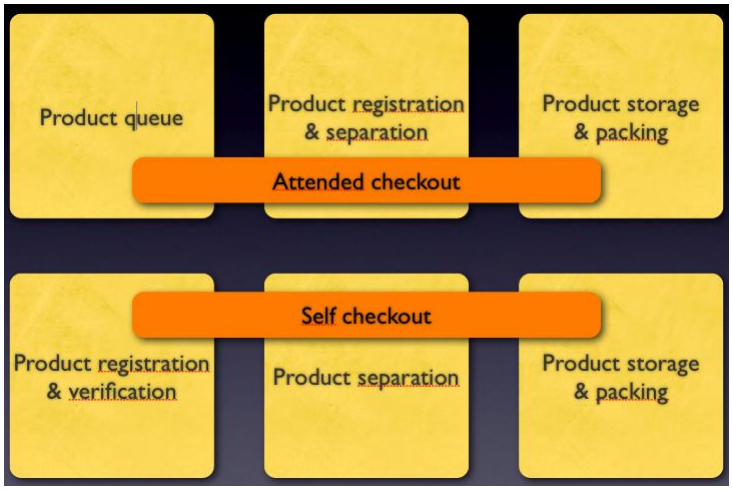


Fig. 9 Zone model

The forming of these zone models has lead to a systematic generation of concepts. The model has made this systematic approach possible because it determined which functions had to be performed in which zone of the system. This meant that some aspects, such as the way the functions were performed and the relative size of the zones, were open for further investigation, which in turn could lead to different design proposals.

4.3 How can these physical arrangement best be realized?

In the previous paragraph was described how a model for each of the two modes of operation of the hybrid checkout system was formed. The consequences of this model for the design concept of the hybrid checkout system were also briefly discussed. In the first section of this paragraph, the remainder of the concept generation will be discussed along with the concepts that were developed. In the middle section, the styling directions for the concepts are discussed and the photo collages that formed the main inspiration for the styling are presented. In the last section, the choice for three of the concepts is explained and these concepts are worked out to a higher level. This section will be closed with the presentation of the three design proposals for hybrid checkout systems that were developed as an inspiration to checkout furniture manufacturers.

4.3.1 Generated concepts

4.3.1.1 Method

In the previous paragraph, the zone models for the two checkout modes were introduced. These models are the result of a better understanding of the various parts of the (self) checkout system and the way these parts are related to each other. The zone models have been the most important inspiration for the generation of design concepts for the hybrid checkout system, because they provide a guideline for which part of the concepts are fixed and which parts allow room for experimentation and diversification.

The most important ways in which the concepts can vary are the following:

1. **Placement of the working area for the attendant**
   The working area for the attendant must provide access to a cash drawer, a barcode scanner, a display monitor and a user interface to the cash register. The attendant must be placed perpendicular to the direction in which the products move when they are processed to prevent a higher risk of work-related injuries for the attendant. This area may be placed at the front belt or right after it. On other places the attendant area is obstructed by the goods separator system and the measures that need to be taken to prevent customers from circumventing the systems security measures. The attendant's area (as this area is called

from now on) must allow the attendant to handle the grocery products. It may be more convenient to do so if the surface of this area is not made of conveyor belt rubber, but rather of a smooth and flat surface such as metal. Therefore, for all concepts that will be generated, a solution for this issue must be considered. In the concepts, this is not further detailed. However, this issue will be addressed when the final design proposals are explained in section 4.3.3.

2. **Dimensions of the front belt**
   The front belt suitable for the Scanpoint self checkout system consists of a conveyor belt with motors that is fitted on a weighing unit and is currently available in two lengths: 90 cm and 120 cm. These dimensions were established by considering the room needed for larger products on one hand and the mechanical complexity of the weighing system on the other hand. To ensure room for larger products, a longer belt is useful. To optimize the weighing system, a shorter belt length gives better results. The available lengths are mechanically and economically acceptable as they are, and can be used at will in the concepts. It is technically possible to develop a front belt with weighing unit with a longer belt, but for this study only the existing dimensions were used in the concepts. This was primarily done to conform to the guideline that explicitly states that using technology that is currently available in the Scanpoint self checkout systems should be pursued.

3. **Goods separator**
   One of the key features in the Scanpoint Lite self checkout system is the goods separation system that allows a customer to start scanning while the previous customer is still packing his or her products from the rear belt of the self checkout system. This is a unique selling point because competing self checkout solutions do not offer such a goods separation system. Competing products either require subsequent customers to wait until the rear belt is free after the previous customer, or simply place the products on the rear belt right next to those of the previous customer. However, this unique selling point was not deemed essential for the success of the hybrid system, mainly because the hybrid system would have other unique selling points. The goods separation system with two parallel rear belts was therefore an optional feature and not a mandatory system requirement. This leaves room for a concept that does not feature this specific goods separation system, which may free up space for other features and functions.

4. **Rear belt size**
   Another aspect of the rear conveyor belts is the belt size. The Scanpoint Lite has two parallel belts that are of large size compared to the packing area on a regular attended checkout. This increases the storage capacity for products on the belts, but also increases the system's footprint. A hybrid checkout system requires the previously discussed attendant's working area, which is nonexistent on a Scanpoint Lite. To compensate for the extra length of this attendant's area and keep within the maximum footprint, it is possible to choose shorter rear belts with a smaller product capacity.

With these parameters in mind, six concepts are created. Each concept features a distinct characteristic, with usually one or a few strong points and one or a few weaker points. These concepts will be discussed below. In attachment D, each of the concepts is explained in more detail

and larger images and explanatory drawings are presented. Two concepts are very similar and are numbered 4.1 and 4.2 in the design process. For this report, the same numbering is applied to remain consistent with earlier reports.

4.3.1.2 Six concepts

4.3.1.2.1 Concept 1 – Extended footprint

For this concept (Fig. 10), the overall footprint was made larger than 100% of a regular checkout, thus failing the requirement for maximum footprint. This is done to allow placement of an attendant's working area while maintaining the storage capacity for products on the rear and front belts. The extended footprint also allows room for a goods separation system like the Scanpoint Lite currently has, which is a tried and reliable solution.

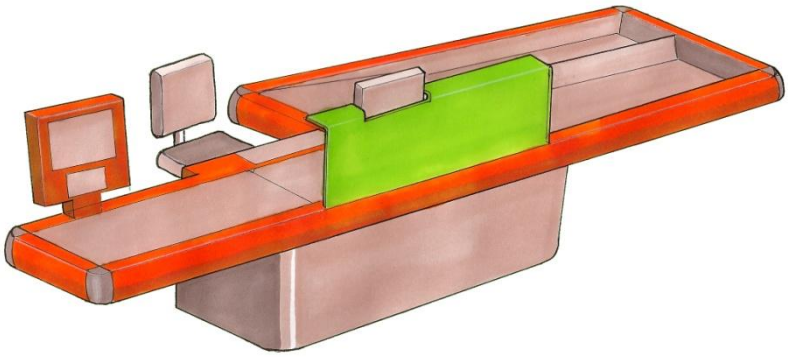


Fig. 10 Concept 1

4.3.1.2.2 Concept 2 - Transformer

In this concept (Fig. 11), the attendant's area is exchanged for a goods separator when the system is switched to self checkout mode. This requires a complicated mechanical construction, but has the advantage of being able to optimally perform in both modes of operation while the system stays within the maximum footprint.

Fig. 11 Concept 2 in Attended mode (left) and Self checkout mode (right)

4.3.1.2.3 Concept 3 – Alternative goods separator

This concept (Fig. 12) is distinctive from the others because of the goods separation method; in the other concepts, the goods are separated by the same system that is currently in use for the Scanpoint Lite. In concept 3, development of an alternative goods separator system is proposed. This alternative system should separate the goods of two subsequent customers, much like the current goods separator, but has to perform this function using less space.

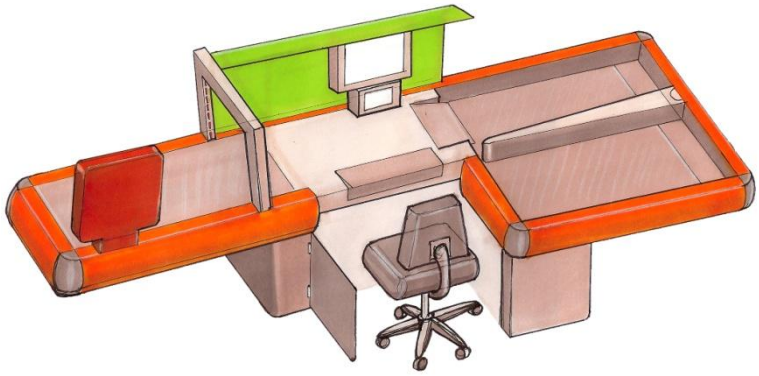


Fig. 12 Concept 3

In this concept, no concessions have to be made regarding the storage capacity for goods on the belt, user ergonomics and functionality. However, a new goods separation system with the set requirements is complex and it cannot be guaranteed that an economically and practically acceptable solution can be found. As an alternative, however, in this concept there is room to let go of the parallel goods storage on the rear belts. This feature, which is a unique selling point for the Scanpoint Lite, is not essential for the success of the hybrid system. For the hybrid system, it would be acceptable to allow only one customer at a system at any time when in self checkout mode. When the system is in attended mode, the attendant can operate a manual goods separator much like the ones seen on regular attended checkouts.

4.3.1.2.4 Concept 4.1 – Full goods separator and packing area

In this concept (Fig. 13), the attendant is seated at the front belt. This leaves little room for products to be stored on the front belt, but allows a fully functional goods separator and large capacity rear belts. Keeping the footprint within acceptable boundaries is not a problem.

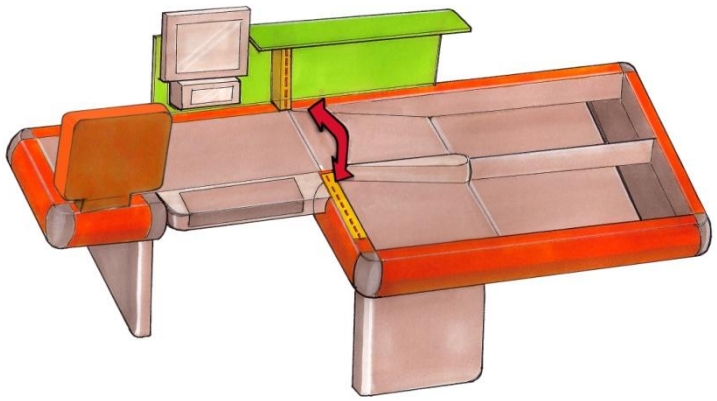


Fig. 13 Concept 4.1

4.3.1.2.5 Concept 4.2 – Front belt slides out

This concept is similar to concept 4.1, because the attendant is placed at the front belt and both the goods separation system and the rear belts are the same size as on the Scanpoint Lite. However, in this concept, the front belt slides outwards, allowing an attendant's working area to 'pop up' from underneath it. In attended mode, this means that the footprint will not be within the set bounds, but it will be in self checkout mode. This may be an acceptable concession.

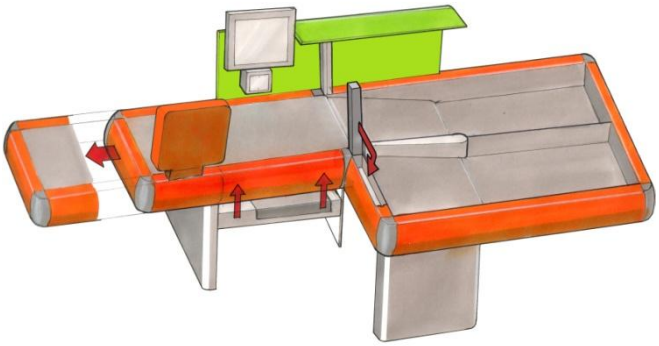


Fig. 14 Concept 4.2

4.3.1.2.6 Concept 5 – Smaller packing area

In this concept (Fig. 15), the space required for the attendant's working area is subtracted from the length of the rear belts. This leaves less room for products on the rear belts. Considering the fact that the rear belts have a high storage capacity compared to regular attended checkouts, a slightly smaller storage area is acceptable. Also, the Scanpoint Lite hardware allows the detection of a full belt. A relatively simple software solution can let the system automatically change to a free belt if a customer has more goods than one single belt has room for. The packing area is shortened by the length of the attendant's area, which is approximately 65 centimetres. This means that in practice, the shorter rear belt is not so different from the existing Scanpoint Lite model.

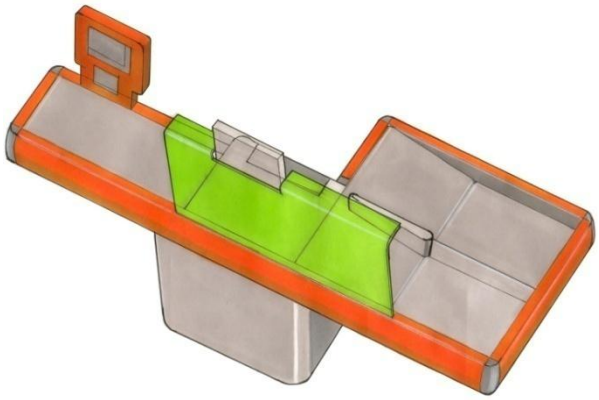


Fig. 15 Concept 5

4.3.1.3 Concept selection

The six concepts that were previously introduced are all considered acceptable design directions, because they are technically and practically feasible, and for the most part satisfy the requirements and guidelines that were set. However, some concepts are more interesting than others because of the way the positive and negative aspects that are attached to each concept are spread. For instance, concept 1 and concept 5 are quite similar. The only real difference is the decision to accept a larger footprint in concept 1 where for concept 5 a lower capacity on the rear belt was accepted. Concept 4.1 and 4.2 are also very similar. In concept 4.1, a lower capacity on the front belt (in attended mode) is chosen to allow room for a full scale goods separation system and full size rear belts. In 4.2, the lower capacity is solved by letting the front belt slide out and allowing an extra attendant's area pop up in the gap that is formed. This keeps the full size of the front belt free for products to be placed on, and gives the attendant a dedicated and optimised working area. The downside is that a more complex mechanical solution is needed to allow the various parts to move.

These two examples illustrate that the different solutions each have strengths and weaknesses, and the relative importance of each of these factors is what makes one solution more interesting than another. In a meeting with selected Scanpoint staff members, all concepts are reviewed. A decision to design three separate hybrid checkout systems in three different styles was previously made and is discussed in the next section. Concluding this project with three different design proposals means that the selection of the concepts is not very difficult: out of six concepts, three are selected to be worked out. Therefore, the selection of three concepts was based on technical and commercial insights of the people that attended the meeting. This method of selection is considered sufficient for the purpose of this study. Inspiration for the design of a hybrid checkout, which is the main purpose of this study, may be achieved regardless of the concepts that are selected. The steps that are taken to transform the concepts into the required design proposals are not difficult to repeat for other concepts.

The outcome of the selection process is that concept 3, concept 4.1 and concept 5 are the most interesting concepts to further work out for Scanpoint. The shared quality in these three concepts is that they are technically not very hard to achieve because neither requires a complex mechanical solution. In concept 3, this holds true because it is chosen not to design a new goods separation system but to apply a manual goods separator, operated by the attendant. Furthermore, all these concepts comply with the set requirement that the maximum footprint may not exceed that of a regular attended checkout. This is considered a very important requirement, because shopkeepers are very sensitive on this subject and they require the shop fitters to keep the footprint of any object in the store as small as possible.

4.3.2 Styling

The styling of the design proposals that are the result of this research project is one of the important aspects of the project. The styling of the current Scanpoint Lite and Scanpoint XS systems is very functional and from a designer's point of view not very strong and clear. The main purpose of the hybrid checkout design proposals is to inspire checkout furniture manufacturers in the design of a hybrid system that works well and looks like a reliable and useful system to fit in stores. Because of the not very convincing styling of the currently available self checkout solutions, the inspiration for the styling of the hybrid checkout had to come from other sources. For this purpose, four photo collages were composed in styles that might be attractive for checkout furniture manufacturers to develop and attractive for shopkeepers to fit in their stores. The most promising style (or styles) is then used in the design proposals for a hybrid checkout system. A possible side effect of these design proposals could be that they inspire the checkout furniture manufacturers to critically look at their current styling and perhaps take over some strong aspects of the proposed styling.

4.3.2.1 Photo collages

In the following table, these four collages are presented with the keywords that describe the most important characteristics. Full page versions of these collages can be found in attachment E.

High Tech

- Playful
- Bright colours
- Plastics
- Transparency
- Mood lights

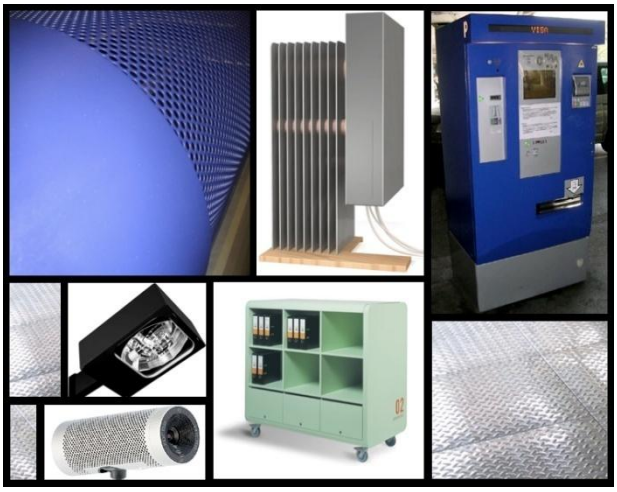
Modern

- Elegant
- Hidden technology
- Minimalist
- Clean
- Few colours
- High contrast
- High quality finish

Friendly

- Colourful
- Soft shapes
- Double-curved surfaces
- Plastics
- User-centred
- Icons & symbols

Industrial



- Robust
- Metal
- Functional
- Corners
- Single-curved surfaces

4.3.2.2 Styling directions

These collages are presented to Scanpoint and were subjected to an evaluation. The Industrial collage was originally designed with the current styling of checkout furniture in mind. This was recognized, but in the evaluation was decided not to pursue this type of styling because it is too obvious. Checkout furniture manufacturers already apply this styling to their products and it is unnecessary to further inspire them in this direction. The other three styling directions are considered of more interest to Scanpoint because they are visually more appealing than the industrial style. Scanpoint decided that it wanted these three styling directions investigated more thoroughly and that therefore three concepts would have to be chosen from the concepts, which is already discussed in the previous section. Each of these concepts is styled after the three remaining collages, resulting in a High-tech, a Modern and a Friendly design proposal for a hybrid checkout.

The selection process for the desired styling directions was not very strict, since only one option was discarded. It is of no surprise that the styling direction that is most useful from a designer's point of view was one of the three that are further explored: the friendly styling. This styling is based on interior decoration and styling elements that are already found in supermarkets, and therefore it is a logical decision to design a checkout system in this style. When the personas are taken into account, this is also the most logical design direction. The styling of the system is most important for the customers, since they will base their opinion about the store on the things they see in the store. If they see something they like, their opinion will grow more positive and when they see something they do not like, their opinion will become more negative. The checkout therefore should look nice in the eyes of the customers. These customers are presented in user personas in an earlier stage of this project. The taste of people is very hard to catch in personas. However, a sense for balance in a store interior is probably present in most people. Therefore, if the checkout is styled in a way that fits with the rest of the interior, most customers will appreciate the design. This will hold true for all personas, but especially for the persona that was chosen as the critical persona, Marianne. She is not a very hip or modern person, but she just wants to do her shopping in a pleasant and friendly environment. If the checkouts are styled in the friendly style that was derived from the pictures of store interiors, Marianne will probably appreciate this. Therefore, also the persona study strengthens the belief that the friendly style is the most interesting and that the choice to continue with this styling as one of three possibilities is well made.

4.3.3 Final hybrid checkout design proposals

In this section, the results of the styling process are presented. The styling as presented in the photo collages has been studied and explored thoroughly by making many sketches. A selection of these sketches is presented in attachment F.

4.3.3.1 High Tech/Concept 5

The high tech styling is chosen to be applied to concept 5, the result of which is presented in Fig. 16. The most important reason is that concept 5 is the most automated concept of the three (because of the required belt management feature, it is even more automated than the existing Scanpoint Lite solution). A side view of this system is presented in attachment G.

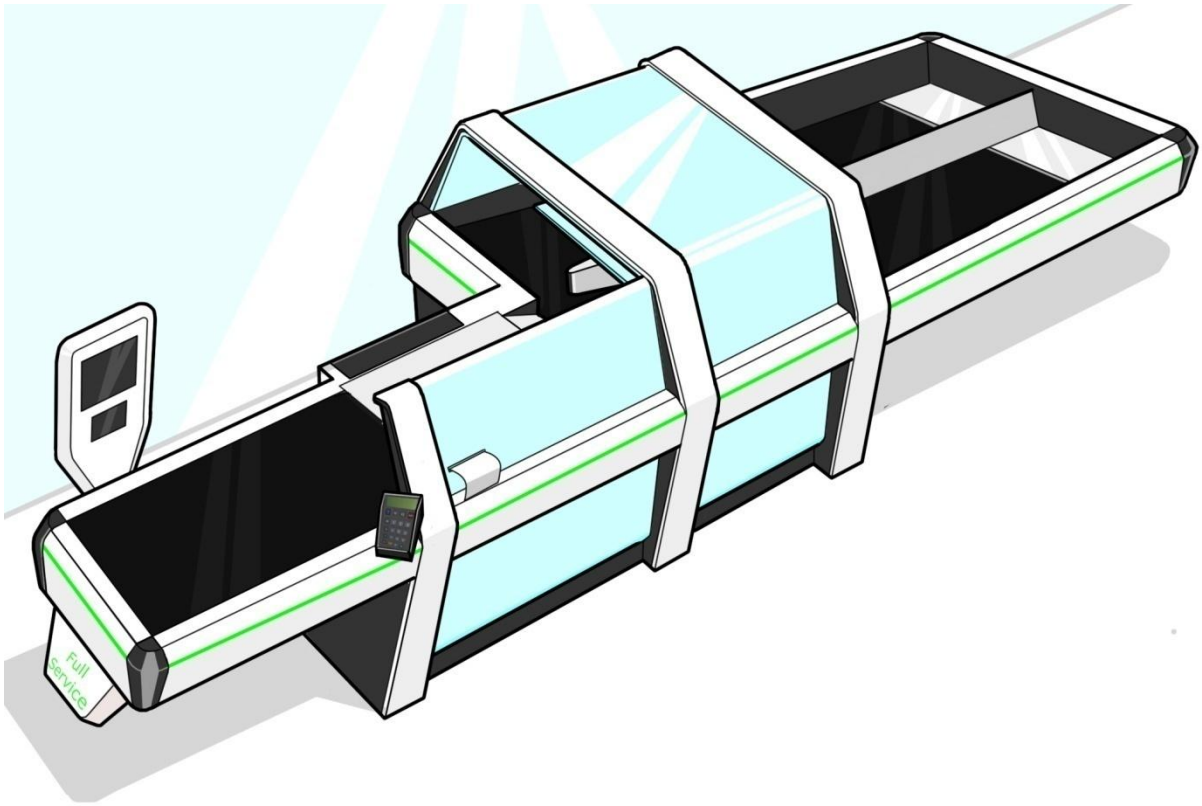
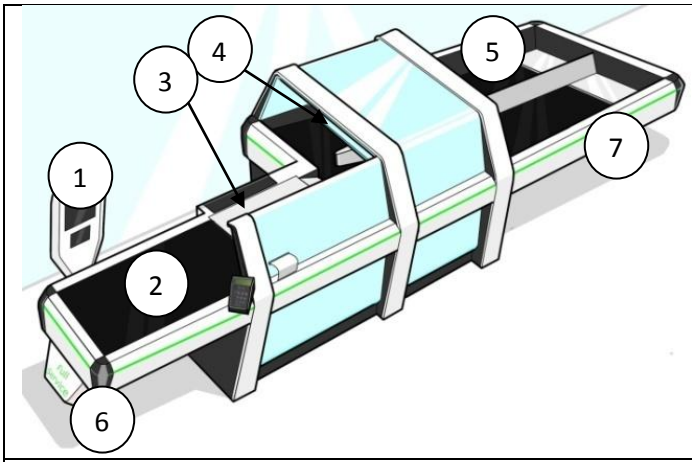


Fig. 16 Design proposal with High tech styling

4.3.3.1.1 Styling and materials

An attempt was made to replicate the look and feel of the bicycle that is used in the High tech photo collage. This was achieved by using similar material appearances. An example is the extruded metal profiles with a high gloss white finish that are the frame for the conveyor belts. A transparent strip, made of silicon or rubber, is inlaid in a groove on the most outward edge of the metal profiles. In this strip, an array of multi-coloured LEDs is placed (Fig. 17 #7). This strip serves two purposes. The first is the physical protection of the glossy metal finish on the metal profiles against bumps from shopping carts and other objects; this is why the strip is made of soft material that serves as a cushion. The second function is the communication of the mode the system is currently in. For instance, if the LEDs in the strip are emitting green light, this could be associated with the attended mode. A blue lighted strip could be associated with the self service mode. These colours would also be used with similar meanings on a LED display that is positioned underneath the front belt (Fig. 17 #6). This display provides a written indication of the mode of operation of the system. This may be achieved by simply laying out the letters of the text “Full” in green LEDs and the letters of the word “Self” in blue LEDs. By printing the word “Service” on the next line, depending on the mode, the sign reads “Full Service” if the green LEDs are on or “Self Service” if the blue LEDs are on. Using both colours and written text to indicate the system status allows people who cannot distinguish between colours to check the system’s mode, while people who can distinguish colours can learn the meaning of each colour, which helps them to choose between different checkout lanes more efficiently. The use of LED technology also puts emphasis on the high tech solution that is provided by the Scanpoint hybrid checkout system. The LED strip around the system could also serve as an error indicator, for instance by changing to red when an error occurs and the service of an attendant is required.

Another place where the styling of the bike returns is the interface unit for customers (Fig. 17 #1). The casing of the barcode scanner and touch screen display has rounded corners with a large radius when seen directly from the front, while the ribbons are a lot less rounded when looked upon from the side. The front of the casing is not flat, but is tapered backwards slightly at the edges. The material used for the housing is sheet plastic (acrylic) which is shaped with the use of vacuum moulding. This production technique is relatively affordable yet delivers a very distinctive and eye-catching result.



1	Customer interface
2	Front belt with weighing unit
3	Attendants working surface
4	Tunnel roof
5	Packing area with two parallel rear belts
6	LED status indicator
7	LED strip

Fig. 17 Key items on the High tech concept

The body of the checkout holds the checkout hardware, provides the required security measures (it functions as the tunnel as seen on the Scanpoint Lite) and provides the attendant with a cabin that serves as a physical barrier between customers and the attendant. The transparent windows are made either of glass or acrylic plate, and allow the customer to look at the entire checkout process. This is meant to give reassurance to the customer that the products are handled with care and nothing happens to the products. The construction pillars are made of a metal frame, covered in plastic to achieve the desired look. The glossy white outer layer is plastic sheet material (or when desired, metal sheet material for better durability). This outer layer is placed on top of a black plastic case that covers the metal frame. The black covers should disappear from view, which gives the glass the appearance of floating underneath the thin white supports.

The overall picture is a high tech checkout solution with a very light weight construction that fits the appearance and description of the high tech collage.

4.3.3.1.2 Mode switching

When this concept is switched from self checkout mode to attended mode, the attendant just has to log herself into the cash register (POS system). This automatically switches the LED sign and LED strip to the appropriate colour. The attendant has to fold the attendants working surface down; this plate is standing up in self checkout mode. A part if the objectsensor (or light curtain) is fitted on the bottom of this plate. When the plate is standing up in self checkout mode, the objectsensor is in its working position; when the plate is folded down, the objectsensor is hidden underneath it. This is the state of the working surface which is shown in Fig. 17 #3. After the working surface is folded flat, a sliding transparent glass or acrylic board has to be pushed to the left by the attendant. This plate is part of the top cover of the tunnel (as seen on Scanpoint Lite), which serves as a physical barrier to prevent customers from placing products past the objectsensor without scanning and registering them. The cover plate that is situated above the attendant's working area hinders the desired

customer-attendant interaction and also limits the attendant's movements. Therefore, this cover is pushed to the left of the attendant, underneath the fixed part of the tunnel, where it remains during attended checkout. In this state it is seen in Fig. 17 #4.

When the system is switched from attended checkout back to self checkout mode, the previously mentioned steps are all executed in reverse. The attendant first logs out of the system, which causes the system to automatically switch the LED lighting colour back to the colour associated with self checkout. The top cover plate of the tunnel, which was pushed underneath the fixed part of the tunnel, is pulled out again. The final step is to rise up the working surface plate, with the objectsensor underneath it, in its standing position. The system is now in self checkout mode.

4.3.3.1.3 Layout

A layout sketch with rough dimensions of this concept is presented in Fig. 18.

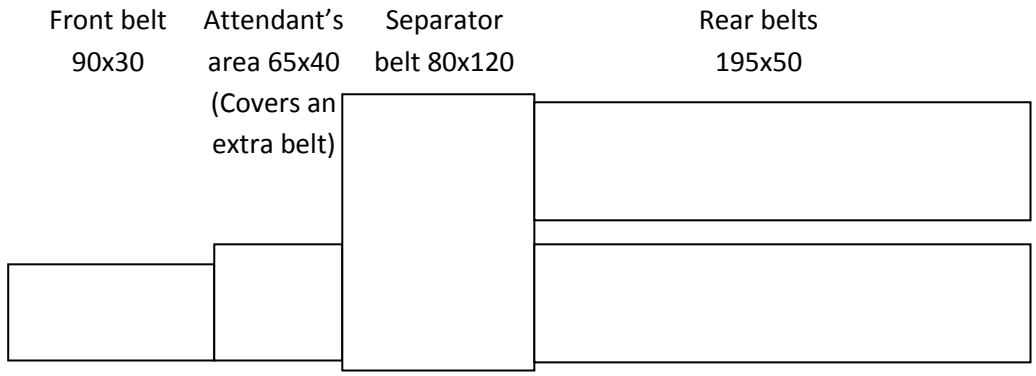


Fig. 18 Approximate dimensions for the High tech design proposal (measurements in cm)

4.3.3.2 Modern/Concept 3

The styling as presented in the Modern photo collage was considered to be most appropriate for concept 3. This solution, which does not have an automatic goods separation system in self checkout mode, is considered more minimalist and to-the-point than the other concepts, an approach that fits the Modern styling. This concept is shown in Fig. 19.

4.3.3.2.1 Styling and materials

The styling of this concept is kept very basic, much like the interior that is presented in the photo collage. Most edges and corners are kept relatively sharp, with corners that are rounded with a very small radius. Most angles between different volumes of the system are 90 degrees. Some corners are rounded with a larger radius to make the overall appearance friendlier. The divider between the customer and the attendant is made of darkened glass or plastic, which is kept slightly transparent (Fig. 20 #4). The dark surface makes the design more elegant and distinguished. It also hides the construction that is needed to allow the attendants working surface to lift upwards when the system changes into self checkout mode. The reason for this is explained in the next section on the mode switching process. The attendants working surface is spray painted dark grey to match the darkened glass. In Fig. 19 and Fig. 20 the plate is kept white to show more contrast.

The base of the system, which is an attendant cabin and provides storage place for the checkout hardware, is a simple box. The base is a rectangular box made of sheet metal with a grey finish to match the darkened glass' colour. The vertical ribs are rounded with a small radius.

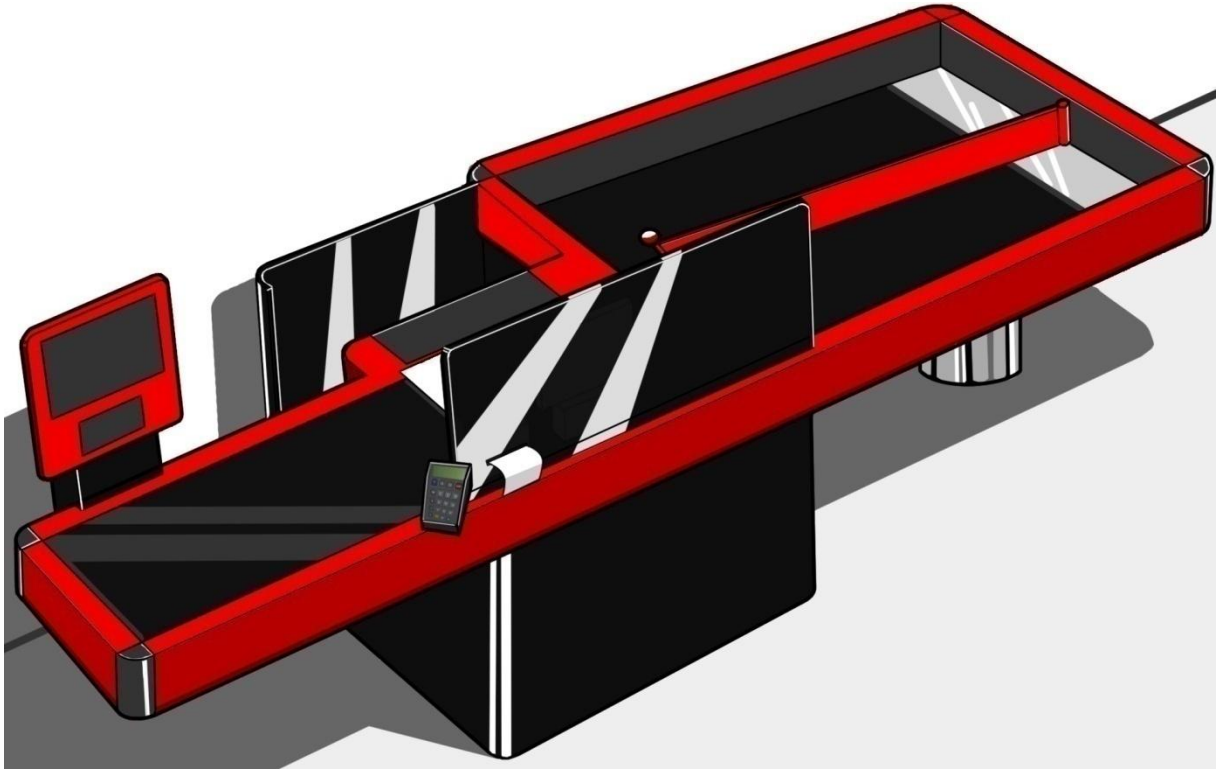
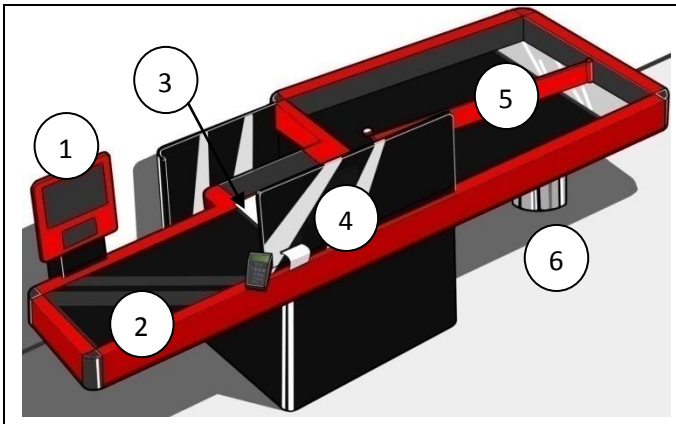


Fig. 19 Design proposal with Modern styling

The packing area, after the attendants' area, is very similar to the packing area of a regular attended checkout (Fig. 20 #5). The main difference is the slope: on this hybrid checkout system, the packing area is horizontal, whereas the packing area on a regular checkout usually slopes downward. The height difference between the front belt and the packing area is in the hybrid system bridged by cascading conveyor belts, which are required for the proper functioning in the self checkout mode. On the packing area, a manual goods separation rod is placed. This rod can be operated by the attendant, and is pushed to the side when the system is in self checkout mode. In self checkout mode only one customer at a time can be served by this system. The next customer has to wait until the previous customer is finished packing and the belt is free.

The packing area is supported by a single pillar with a polished metal finish that resembles chrome (Fig. 20 #6).

The interface for customers features a touch screen and a barcode scanner. These are placed behind cut-outs in a sheet of metal or plastic. This sheet is rectangular, with rounded corners. Behind the sheet, the touch screen and barcode scanner are covered by a very basic metal casing. The sheet extends over the edge of the metal casing, causing the interface panel to appear very thin when looking from the front or at a small angle.



1	Customer interface
2	Front belt with weighing unit
3	Attendants working surface/top of tunnel
4	Divider screen
5	Packing area with manual goods separation rod
6	Pillar

Fig. 20 Key parts of the Modern concept

4.3.3.2.2 Mode switching

When the system is switched from self checkout mode to attended mode, the following steps are executed:

1. The top of the tunnel is pushed downwards. This plate forms the working surface in attended mode. In attended mode, it covers the extra belt (Fig. 20 #3). This extra belt is needed in self checkout mode to allow products to pass the entire system. The objectsensor is attached to one of the support rods of the tunnel top/cover plate. When the cover plate is moved downwards, the objectsensor is pushed downwards along with the support. Stabilising rails are used to ensure a tightly controlled positioning of the objectsensor, which is essential for its operation. When the plate is pushed downwards, gas springs are pushed in. These are used to help lift the surface up when the system is switched to self checkout mode.

2. The attendant logs on to the cash register (POS system). This causes the extra belt (now underneath the working area) to lock. It also changes the mode indicator, which is a software feature presented on the customers' touch screen.

When the system is switched back to self checkout mode, the following happens:

1. The attendant logs out of the POS system. This causes the extra belt to unlock, allowing it to move when the system requires it. Also, the mode status on the customer's screen is changed back.

2. The working area is lifted upwards by the attendant. Gas springs under the supports help lift the weight of the cover plate. When the working surface is in its highest position, it serves as the top of the tunnel of the self checkout system. The objectsensor, attached to the support, is repositioned in this same movement. The rails allow the support to be positioned very precisely, ensuring proper operation of the objectsensor.

4.3.3.2.3 Layout

A layout sketch with rough dimensions of this concept is presented in Fig. 21.

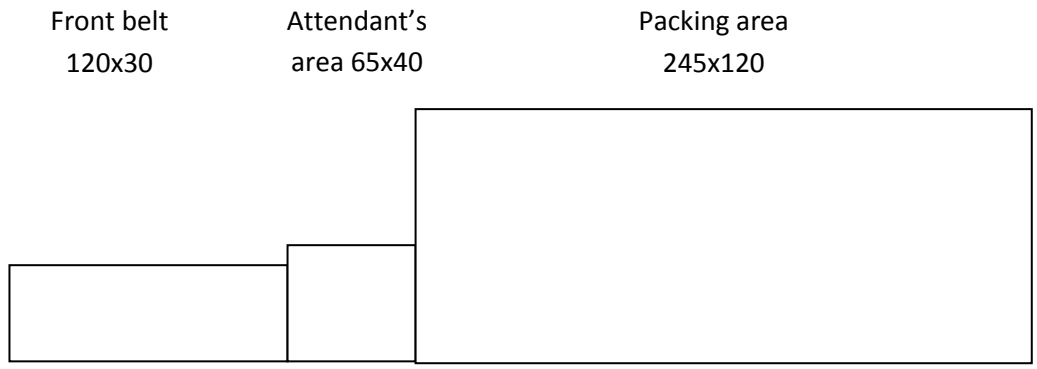


Fig. 21 Approximate dimensions for the Modern design proposal (measurements in cm)

4.3.3.3 Friendly/Concept 4.1

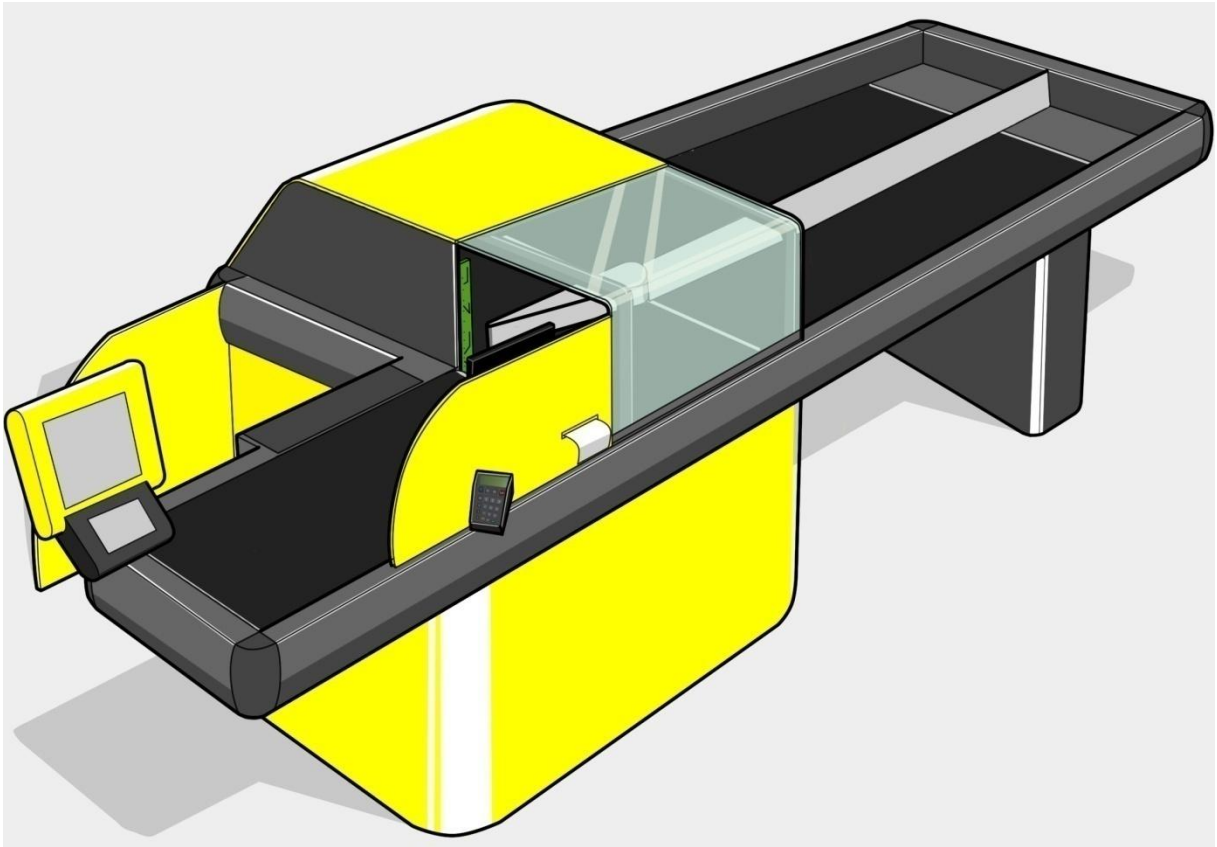


Fig. 22 Design proposal with Friendly styling

The Friendly style as presented in the photo collages is based on the trend, spotted in supermarkets, to communicate the corporate identity using friendly shapes and colours. The customer is approached with clean, simple signs with bright and friendly colours and many rounded shapes. Icons and symbols are presented everywhere to make the shopping experience more convenient and pleasurable. The design language presented in the photo collage is very suitable to be used for checkout systems, mainly because such systems will operate in the environment that was used as an inspiration. Concept 4.1 has been selected to be further developed in the Friendly style. The result is shown in Fig. 22. A side view of this system is presented in attachment G.

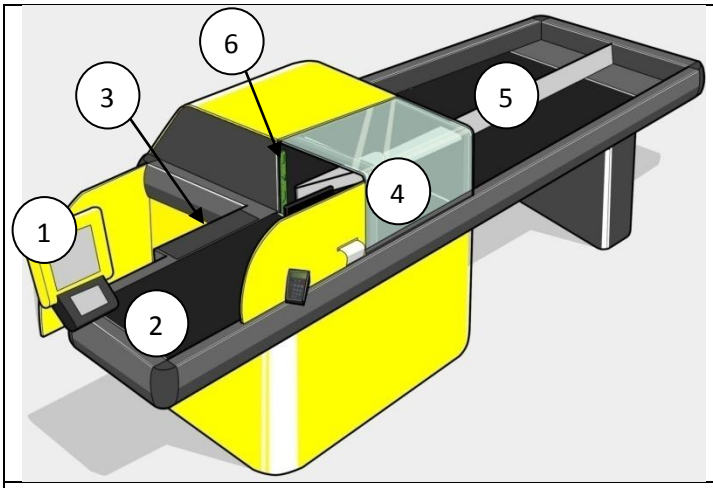
4.3.3.3.1 Styling and materials

The styling of this concept was a direct translation of the styling seen in the photo collage. The yellow and grey coloured camera was the principal inspiration, not only suggesting the colour scheme but also showcasing a pretty solution for the support frame of the tunnel.

The tunnel is built of plastic sheets (acrylic) over a frame of metal tubes. These tubes are finished with glossy grey lacquer, similar to the support of the camera on the photo collage. Half of the acrylic tunnel is non-transparent yellow plastic, while the half that is at the customer side is clear, transparent plastic (Fig. 23 #4). This allows the customer to follow the products when they are transported on conveyor belts through the checkout system. The glossy grey support tubes are visible through the transparent plastic which gives a very open, transparent impression.

Because the tunnel starts at the end of the front belt with the weighing unit, the objectsensor may be fitted in the tunnel and does not need to move during a mode switch. This is very convenient, because accurate placement of the objectsensor is a delicate matter that requires a very well thought out mechanical solution in the other two design proposals.

The attendant is seated directly at the front belt (Fig. 23 #3), and the attendants' barcode scanner and touch screen are kept out of the customer's sight by a plastic yellow screen, that is placed right next to the transparent part of the tunnel. This screen only extends halfway the front belt, which is the longer 120 cm model, leaving plenty of room for the customer to place products on the belt. The front belt does not move autonomously in attended mode, but can be started and stopped manually by the attendant. This can be achieved by adding a switch near or on the attendant's footrest, which can be activated by the attendant's foot.



1	Customer interface
2	Front belt with weighing unit
3	Attendants working area with cash drawer
4	Transparent tunnel
5	Packing area
6	Objectsensor

Fig. 23 Key parts of the Friendly concept

After the front belt, as stated before, the tunnel begins immediately. Inside the tunnel, directly after the objectsensor, a goods separation system like the Scanpoint Lite is placed. The tunnel ends after the goods separation belt, around the place where the rear belts start. This design features two parallel rear belts of the same length of a regular Scanpoint Lite system.

The interface for the customers consists of a barcode scanner and a touch screen. Each of these items is placed in a metal box with a rounded top and bottom (Fig. 23 #1). The smaller, grey barcode scanner case is placed sticking out underneath the larger, yellow touch screen case. The barcode scanner case may tilt slightly if that is more convenient for the customers.

4.3.3.3.2 Mode switching

In this concept, the mode switching is relatively easy. When changing from self checkout to attended mode, the attendant just has to take a seat at the attendant's area, which is located at the front belt, and log in to the cash register. The mode change is displayed on the customer screen. No mechanical actions have to be taken in order to switch. The attendant works directly on the belt. This is less comfortable, but may be acceptable because of the fast mode switching time. The objectsensor in this concept is placed inside the tunnel in a fixed position, which is very reliable. To switch from attended mode to self checkout mode, the attendant just has to log out of the cash register.

4.3.3.3.3 Layout

A layout sketch with rough dimensions of this concept is presented in Fig. 24.

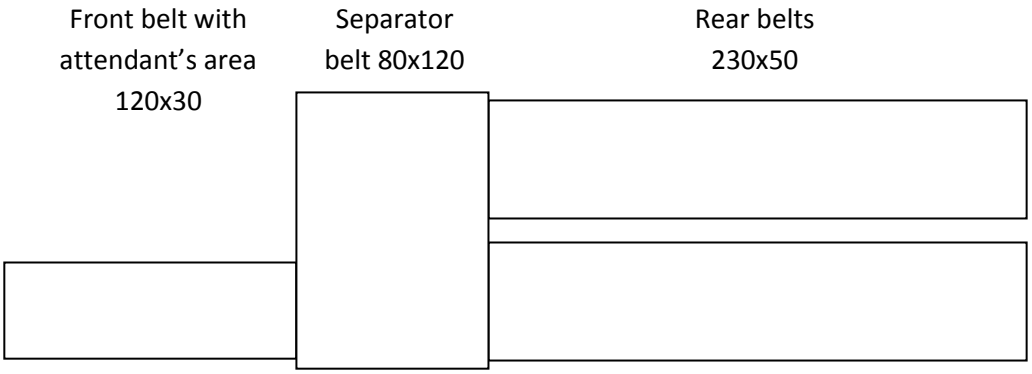


Fig. 24 Approximate dimensions for the Friendly design proposal (measurements in cm)

4.4 What are the global costs for the designed hybrid checkout systems?

In this section, an estimate is made of the total costs of the various design proposals for the hybrid checkout system. All of the costs are list prices, meaning that this is what the parts will cost for the retailer that wants to buy them for his store. A few remarks need to be made. First, these prices are estimates. They are indications of the costs for the various parts, but there was no effort put in getting the lowest prices for each product. Some prices are directly from the Scanpoint price list, others are estimated based on the prices of similar items. This is the case with the conveyor belts of the systems, as well as with the price of the checkout furniture. The estimates were made by Erik Kooi, Manager Hardware Development & Manufacturing at Scanpoint. He has worked on the development of all existing Scanpoint systems and his best guess is therefore considered a good base for these calculations. Second, the prices may be different in a real-world situation. Many prices are lower when the items are bought in larger quantities. Scanpoint also has special bulk prices for their products. These special prices are not taken into account because they can be different for each situation. Third, the decision was made to use list prices, rather than cost prices[5], because the various companies involved in this research project want to keep cost prices unknown to their clients. This report is mainly of interest for the checkout manufacturers who have to build the hybrid checkout systems, and therefore cost prices would have been more useful. However, list prices are an

[5] Cost price is the purchase price of the parts for the checkout manufacturer, without the added value of the installation and customization process.

acceptable alternative because checkout manufacturers will get a general idea of the cost prices if they see these list prices. The last remark concerns the parts that are included in the calculation. These are the parts that are included in the price list that is used by Scanpoint for its customers. The items are all custom designed or selected for the self checkout system. An estimate is also made of the costs for other essential parts that are not supplied by Scanpoint. These parts are never included in cost calculations by Scanpoint because these parts are supplied by another party. Therefore, they are not taken into account in the cost evaluation in the next section. They are included to cover some items that are shown in the concept drawings.

4.4.1 Estimated list prices for the three concepts

The estimated list prices are given in Fig. 25. The calculations for these list prices can be found in attachment K.

Concept	**Price**
High Tech	€23.765,00
Modern	€17.473,00
Friendly	€21.465,00
Scanpoint Lite model by Van Keulen Interieurbouw	€20.000,00
Other essential parts	€ 4.200,00

Fig. 25 Estimated list prices

4.4.2 Cost evaluation

The costs presented in the previous section are estimates for the total price of the hybrid checkout concepts. They are a fair indication of the actual price of the concepts. Most interesting is to compare the total prices with the total price of the Scanpoint Lite by Van Keulen Interieurbouw, which is currently the most widely applied self checkout model. The list price of the VKI Scanpoint Lite that most closely resembles the size of the hybrid checkouts is around €20.000,00.

The High Tech concept is estimated to cost around €23.765,00 and is the most expensive of the three. This is because the system features everything the Scanpoint Lite model features, is more expensive to produce due to different materials that require a more expensive finish, and requires an extra conveyor belt.

The Modern concept is the least expensive, and costs roughly €17.473,00. This is lower than a Scanpoint Lite, mainly because there is only a manual goods separation rod and not an automated mechanical system.

The Friendly concept is priced slightly higher than a Scanpoint Lite at €21.465,00. The price difference with the Scanpoint Lite is mostly due to the extra hardware that is required for a hybrid system. The furniture and the mechanical systems closely resemble the Scanpoint Lite, and are estimated to cost roughly the same.

A very interesting conclusion is that at least one of the design proposals, the Modern concept, is estimated to cost less than the Scanpoint Lite. This is mainly due to the absence of an automated goods separation system. If this is an acceptable disadvantage, then this concept is an attractive hybrid solution that is very cost effective. The other, higher priced hybrid checkout systems have the same self checkout functions as the Scanpoint Lite model, which has proven to be successful. The added costs for a hybrid system seem reasonable, considering the advantages these systems provide.

5 Design evaluation

In this chapter the designs for a hybrid checkout will be evaluated. This will be done by checking if the functions are implemented and requirements are met. Furthermore, Scanpoint has offered some feedback on the designs that will be discussed. Finally, some other remarks about the designs are made that are of value for a complete and thorough evaluation.

5.1 Evaluation of the functions and requirements

In this section will be discussed if the design proposals, which were created during the project, can perform the required functions and if they meet the requirements that were formulated. Alongside the functions and requirements, there were also guidelines formulated to steer the design of the hybrid checkout in the right direction. These guidelines were used during the design process, but because it cannot be indisputably proven that these guidelines were followed, there is no evaluation of the guidelines.

5.1.1 Functions

The functions, as described in section 3.2, were used throughout the concept generation process. This has resulted in concepts that perform all functions. It must be noted that not all functions that are specified are worked out for the end concepts. For instance, the functions that are related to communication with the POS (Point of Sale) system and functions of the (graphical) user interface are not worked out in full detail. However, for each function the necessary hardware was added to allow it to function. The systems electronics and software, which were not a part of the design process, need to support these functions as well.

Some functions are performed better than others. Functions that leave room for improvement are the mode switching indicators in all three concepts. The switching of modes is only presented in the system's customer display. It would be better to have a separate indicator to warn for mode switches. Another function that could be performed better is the mode indicator in the Modern and Friendly concept; unlike the High tech concept, which shows the current mode on a LED display and LED strip, these concepts have no mode indicators apart from the customer display. It would be better if these two concepts would have a separate mode indicator, like the High tech concept.

The functions that need to be performed by a hybrid checkout system in order to properly function are mostly implemented in the three design proposals.

5.1.2 Requirements

The requirements, much like the functions discussed above, were used as input for the design process. (The requirements are found in section 3.4.) This has resulted in design proposals that meet the set requirements, as far as this may be concluded from the level of detail of the proposals. This is a very important remark, because in the case of many requirements the design proposals are not detailed enough to properly judge if they meet the requirements.

The requirements that are related to the physical dimensions of the design proposals are particularly difficult to evaluate because for the design proposals, not all dimensions are defined. Very rough proportions were determined to check if the set maximum footprint could be achieved. Also, this was done to determine if the layout allows the design to operate as intended. For instance, by roughly choosing the various dimensions it was checked if there would be room for an attendant and if the

various users would be able to operate the system. However, these estimates are not conclusive and cannot be used to determine if the requirements that are related to these dimensions are met. The estimates are accurate enough so that may be concluded that with the given design proposals, it is at least possible to meet the specified requirement. The same holds true for many of the other requirements.

The design proposals are not as detailed as the system requirements and therefore cannot be used to determine if the requirements are met. However, because of the estimations that were used during the design proposals, these design proposals are solid basis for the design of more detailed hybrid checkout systems that do meet the requirements. Since this was the objective of this project, this is an acceptable result. The requirements are considered to be accurate. Some requirements may need to be more clearly specified to successfully design a new system, but generally these requirements are a good foundation for future designs of hybrid checkout systems. They can therefore be used for future reference by checkout manufacturers if they decide to design a hybrid checkout system.

5.2 Feedback from Scanpoint

During a meeting, the three final designs were presented to Scanpoint. The general consensus was that the designs were useful and promising. The goal for Scanpoint was to investigate how a hybrid checkout could be materialised within the existing self checkout solution. The final results of this investigation they were expecting were three concept designs for such a hybrid checkout system that could be used to inspire checkout manufacturers to design and build this system. From their point of view the design proposals that were presented in the previous chapter are exactly that, and therefore they conclude that the end result meets their expectations.

5.2.1 Feedback on the three systems

5.2.1.1 High tech concept

The High tech system received the most positive feedback. This was mainly because the styling was attractive and there is little compromise on the functionality of the system. As a negative point, the LED display underneath the front belt was mentioned; this display will not be visible if a shopping cart is parked in front of it. It would be better to look for a different location for the display to ensure that is will be clearly visible at all times.

5.2.1.2 Modern concept

The Modern system was the least well received of the three. The positive points were that it is simple and straightforward to use and offers a low-cost hybrid checkout solution. A negative point is the colour, which is relatively dark and therefore this system will probably not fit in a supermarket very well. The colour and styling does match that of the collage, but a lighter design is a possibility, for instance by using a lighter red paint or exchanging the dark grey and black parts for lighter grey or white parts. In section 6.2, the recommendation is added to further explore colouring options for the various designs. Another weakness of this system is the working surface that has to lift up to form a tunnel; this solution is mechanically very complex to design and manufacture, especially because the objectsensor needs to be placed very precisely.

5.2.1.3 Friendly concept

The friendly system was also well received, but it was not as popular as the High tech model. This could be due to the fact that the styling is more mundane than the High tech model and due to the

fact that the mode switching procedure is not as exciting. However, the simplicity of the usage of this concept was appreciated, and the styling was considered useful for the supermarket environment. The question was raised if the attendant will have enough room to manoeuvre products around, because the attendant is seated close to the tunnel. This could be solved by moving the attendants interface items and the cash drawer more towards the front of the system, but this would mean that there is even less space on the front belt to place groceries on. This leads to a general recommendation in section 6. 2 for all the concepts that the physical dimensions should be examined, with special attention to the space that is available for the attendant to work in.

5.3 Further evaluation

One of the important advantages of self checkout is that there is no need to have an aisle between all checkouts. Scanpoint Lite self checkout systems can be placed directly next to each other, which saves valuable floor space in the store. The customers will have to walk around one or a few checkouts to reach their groceries on the packing area, but this is a minor inconvenience. On the other hand, conventional attended checkouts require an aisle between each checkout. This takes up considerably more floor space, while the actual size of a regular checkout is not much bigger than the actual size of a self checkout system. Because there is no need for an aisle, the self checkout solution can offer more checkouts on the same floor space. The hybrid checkouts that were designed for this project, however, do not share this advantage. All three design proposals require one aisle per checkout and thus require more floor space than the Scanpoint Lite self checkout system.

The costs of some hybrid checkout systems are higher than those of a Scanpoint Lite self checkout system, which in turn is more expensive than a regular attended checkout. The advantages of the hybrid checkout are worth the extra costs. However it is recommended that a careful consideration is done to determine how many of each checkout type is required in a specific store. This is added in the recommendations in section 6.2.

6 Conclusions and recommendations

6.1 Conclusions

In this paragraph, the results of this project will be discussed. First will be decided whether or not the project objective, which has been defined during the planning stage, has been achieved. After this will be discussed if the design proposals, which are the final result of this project, are acceptable and useful for Scanpoint.

6.1.1 Project objective

In the plan for this research project, the following objective has been defined:

“The objective for this assignment is the designing of a reference design of one or a few checkout systems that are suitable for both conventional checkout and self checkout. Multiple technical design concepts will be generated, the emphasis of which will be on product presentation. Working principles, parts, material selection and costs will be approximately specified.
This can be realised by researching the market for checkout systems, analyzing the usage of such systems and specifying the functions and requirements of the system that will be designed. The results of this research will be used for the designing of concepts for new checkout systems, which will

be worked out into one or a few reference designs. All this will be executed over the course of 13 fulltime working weeks."

The first part of the objective states exactly what the goal of the project is: what is the end result that is pursued. The end result of this project is the completion of three concepts, which are presented as design proposals for a hybrid checkout system. For these three design proposals, the working principles, parts, materials and costs are loosely defined. This end result comes very near the result as described in the objective. The decision to work out three concepts to three design proposals meant that the level of detail in each design is lower than the level of detail that would have been achieved if the focus would have been on fewer concepts. The final three design proposals meet the expectations Scanpoint had, as is described in chapter 5. Therefore may be concluded that the obtained level of detail for the design proposals is acceptable and therefore that the objective has been completed.

The second part of the objective states which steps are taken to reach the end result. These steps were defined in more detail in the project plan. During the course of the project, not all steps were taken as they were described; however the results of each of these steps closely resembled those that were initially envisioned. Therefore may be concluded that the route towards the project goal, as described in the project objective, was followed loosely, allowing for additions and revisions of the plan when this seemed appropriate. As an example, during the research into the users of checkout systems, the decision was made to do a Persona study. This study, which is described in this report and evaluated separately later on in this chapter, was not a part of the original project plan. On other occasions, less obvious alterations were made to the way the steps were taken. These alterations were never of influence on the steps that were established in the objective as quoted above.

The above discussion on the objective leads to the conclusion that the project was a success because the objective is achieved.

6.1.2 General conclusions

The preliminary research into the market, the users of checkouts and the stakeholders has been a good base for the rest of this project. A hybrid checkout system is not yet available, while various stakeholders have stated that they think such a system would be useful. The requirements that were created for this project are of value for checkout manufacturers, should they decide to build a hybrid checkout based on the Scanpoint Lite self checkout system. The other concepts for hybrid checkout systems, which were not used for the three final design proposals, could also be used as design inspiration, as is the case with the photo collages that are used to investigate styling options for checkouts. Based on the evaluation of the design proposals in chapter 5, the design proposals have the quality and level of detail Scanpoint had in mind when the assignment was issued. These design proposals are technically practicable, and based on cost estimates they are economically feasible as well. Therefore it is concluded that this project has been a success.

6.2 Recommendations

At the end of this project, the following recommendations are done:

1. A hybrid checkout system is a feasible addition to the range of Scanpoint self checkout systems and is worth developing. This is based on the reception by the users during the interviews, as well as the final results that prove these systems can be realised. The reception

of the design proposals by Scanpoint was positive. The current market situation also leaves room for a hybrid checkout system, since such a system is not yet widely available.

2. The design proposals designed during this project each have stronger and weaker points. To determine which of these proposals is the most interesting one to develop, further research into the specific wishes of the shopkeepers is needed. This could be achieved by presenting the results of this study to shopkeepers and asking for their opinion and feedback on the design proposals.

3. Of the three used styling variations, the Friendly style is probably the most interesting for shopkeepers because it fits best with contemporary shop styling. The Modern and High tech styling variations are less interesting, because these do not match the atmosphere of modern day supermarkets. This project however has proven that the design and styling of checkout furniture, regardless of its purpose, is not limited to the available production techniques. In modern day supermarkets the communication of the store image is done through every aspect of the store interior, and checkouts can play a significant part in this. Checkouts are very suitable for this function because they are large and have a prominent place in the store.

4. The persona study that was conducted as part of this research project could be a good place to start investigating the user requirements towards self checkout systems more thoroughly. For the furniture design and the general working principle of the hybrid checkout, as presented in this project, the personas have not been very useful. If the operating procedures and the user interface of the self checkout system are subject of a redesign, these personas could be more useful to make specific design decisions. In this situation it is recommended that the personas are used.

5. The optimal distribution of regular checkouts, self checkouts and hybrid checkouts for specific situations in the store should be examined. In section 5.3.1 is described that the designed hybrid checkouts require an aisle, just like a regular checkout. In this same section is also described that the hybrid checkout is more expensive than the other two checkout types. It is useful if a study is conducted towards the optimal distribution of checkout types. This study should combine the experience gathered from equipping stores with self checkouts with a scenario analysis to determine how many self checkouts, attended checkouts and hybrid checkouts should be placed in a store to get the most of the positive aspects the systems offer, while keeping the total costs as low as possible.

6. The dimensions of the presented designs are estimates, and therefore no conclusions could be done towards the usability of the systems. Further research into the usability is needed to ensure that the system can be used as intended. In this research, special attention must go to the space that is available for the attendant to work in, to ensure that the various elements of the hybrid checkout system (for instance the tunnel) do not obstruct the attendant.

7. The colours for the various designs are indications. To enhance the appearance, an extra feedback loop (iteration) in the design process could be useful to reflect if the designs are styled like the photo collages. This could lead to better styling and colouring decisions.

6.3 Personal evaluation

6.3.1 Takeover

Over the course of my project, the company I was working for, Scangineers, was acquired by Itab. Itab, a Swedish company that is specialized in shop fitting projects, already was a business partner of Scangineers and has had a Scanpoint Lite self checkout system under development for a few years. The acquisition of Scangineers by Itab has secured the future of the company. The company was renamed Scanpoint to strengthen the tie with its line of Scanpoint self checkout systems. With such a large company behind it, Scanpoint now has the resources to develop new self checkout products and services.

The acquisition was a lengthy and complex process which was quite interesting for me to observe as a relative outsider. It has been one of the most discussed topics during my stay at the company and I have learnt a lot from it. It also meant that key staff members were quite busy, which made the planning of milestone meetings for my project not always easy.

Overall, the takeover has not had a significant impact on my project.

6.3.2 Project planning and execution

The planning of this project was at first very detailed. After consulting with the tutors at the company and at the university, it was decided that the original planning was based on too many estimations and it was too complex to work with. Therefore, a more compact, less detailed planning was made. This planning has been used throughout the project to monitor progress and schedule milestone appointments with Scanpoint personnel.

The first half of the project the planning was followed without noticeable deviations. From the concept generating phase onwards, the project got behind on schedule. Unfortunately the delay grew as the project neared the end, for various reasons. One of these was a misunderstanding regarding the level of detail the concepts should be in before a founded decision could be made, and it took a few days extra to improve the concepts. The scheduling of milestone meetings was also a factor in the delays, as it was difficult to plan a meeting that could be attended by the right people. When this meeting finally took place, it took more time than was expected and a decision could not be made. The time between these meetings could only partially be filled with scheduled work, because of the importance of the decisions that had to be made in this meeting (the selection of the final three concepts). The most important factor of the project delay was the time it took to complete the final design proposals. The time scheduled for this activity was a lot less than was needed. This was a weak point in the planning to begin with, but the extent of the delay that was caused by this miscalculation was a lot greater than I had considered. Partially this was because the decision was made to work out three design proposals, while in the planning only one or two proposals were calculated.

The delay was of no problem for the company, since they did not need the result of this project on short term. Therefore, they gave me a deadline ‘when it’s done’, a freedom I have used to work out the project to a level that was more acceptable than the result after the 13 weeks that were initially projected.

6.3.3 Learning points

During this project, I have learnt very much about how industrial designs by small companies are introduced into the market. The checkout market has been very interesting to study because so many parties work together to get the final product operational in the stores.

I have also improved my drawing skills to some extent. I have tried to apply a chosen styling on an existing technical concept, which I think was a success for the most part. I have also picked up some skills with Photoshop to improve the quality of the drawings.

What I have found to be most interesting about this project, however, is working in a corporate working environment. I found that it was sometimes hard to effectively spend a full working day doing the same work. Despite this, I feel that I have reached a satisfying result. Working with the same people for a few months has also been a nice experience and I have greatly enjoyed that aspect of this assignment.

6.4 Evaluation of the persona study

In the planning stage, a persona study has not been considered as an option to investigate the wishes and requirements of the users of hybrid checkout systems. Somewhere during this project, this study was added because at that time it seemed a very useful method to investigate the various users. Therefore, the data of the customer and employee interviews that were taken, as well as discussions on the various users of checkout systems, were used to create various user personas. The personas seem to be credible and may be very useful to help make design decisions. However, there were not many decisions during the design phase of this project that required personas to make. This was mainly because the focus of this project was not on the user interface and the operating procedures of the (self) checkout systems, since these were already available. The focus of this research project was rather on the styling side and the physical layout of the hybrid checkout system, as well as the basic technical working principles. The styling decision could be at least partially verified by looking at the personas. However, the personas were not an essential part of the decision. The physical layout of the systems was achieved by arranging and rearranging various essential checkout parts, and the decision of which arrangements were useful as concepts could be made by carefully weighing the pros and cons. The technical decisions were made with the help of experts and using other techniques. The personas were not needed to make these decisions. The same holds true for the selection of the three final design proposals, which was not made by looking at the personas but rather by looking at the stakeholders of the system that were defined in a separate section of this research project.

When looking back at the project, the benefits that were had by conducting the persona study are not very great. It was moderately useful in the styling decision, but apart from that the personas were not used. The amount of work that went into the creation of personas, on the other hand, was considerable and therefore the conclusion is that it was not worthwhile for this project. The most probable cause is that the level of detail of the design proposals was not high enough that the differences between the personas could make a difference. When a hybrid checkout is designed in more detail than these design proposals, the personas may be more useful. As already noted in the recommendations, the personas are probably most useful in projects that are related to the operating procedures and the user interface of hybrid checkout systems.

Final words

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