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The Multi Lingual version also provides support for multiple character sets and allows the Installer to choose the character set that matches the Language provided in the Control Module firmware. The module number and other options are programmed from the keypad. Flush or surface mount options, Tamper monitoring, Zone Inputs and Auxiliary outputs are provided. TX05 Aux. 5. Internal Beeper. TX06 Aux. 6. LED 1. TX07 Aux. 7. LED 2. TX08 Aux. 8. LED 3. Page 2 and 3 p2 MultiLingual Elite LCD Terminal Page 4 p4 MultiLingual Elite LCD Terminal Thank you, for helping us keep this platform clean. The editors will have a look at it as soon as possible. You must have JavaScript enabled in your browser to utilize the functionality of this website. Users can use the keypad to perform typical operations on Integriti, Concept and Inception systems. This includes control of security areas, door access, event activity review and controlling the state of outputs. The OLED LCD display shows plain text navigation through operations and alarms, events and items are presented by name. This allows the installer to make quick and efficient changes as needed without having to access the software. The EliteX supports 12 Languages. You must have JavaScript enabled in your browser to utilize the functionality of this website. It is a hybrid recorder compatible with AHD, HDTV, traditional standard definition analogue cameras, and IP cameras. The DVR offers a range of features suited for advanced applications, including remote monitoring station integration, P2P connectivity for remote viewing on mobile devices, and compatibility with the licensefree iPIMS VMS. The 8 Channel Digital Video Recorder allows you to connect a maximum of 8 cameras in an IP and AHD combination. Perfect when monitoring large or multiple sites with a high number of cameras. These features are available on all VXH5AHD Recorders as standard. <http://gasasosong.com/upload/fckeditor/93-accord-manual-pdf.xml>

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For end users, this means they can be notified of any activity on their premises wherever they are. This function allows the user to build up a list of events for easy a convenient archiving. The administrators can allow or restrict operation for an individual user from the following functions Dual streaming technology allows faster transmission to smartphones, tablets and remote monitoring stations whilst still recording at the native fullsize resolution on the recording unit, taking the strain off the network bandwidth when trying to access a Concept Pro recorder remotely. Specifications may vary depending on model. If any abnormalities are detected a user can be notified by email or alarm output. Users may configure the settings of panic recording. The system shall also allow a hard disk event to be configured to trigger various alert linkages to warn when disk capacity is or is nearly exhausted. Video archived in the AVI format may be played back in Windows Media Player provided the IMM4 codec file is installed on the client PC and the file was recorded using H.264 video compression codec. Alternatively, one output may be selected to serve as the main monitor and the other as a spot monitor. These devices shall be setup with the use of hexadecimal text data parameters and the text display shall be configurable. A corresponding text log can also be submitted to the device using this Virtual Alarm SDK. Additionally, the device shall support the free DVRLINK.NET DDNS service for out of the box domain name service. The device shall be able to send a test email to ensure email server settings are correctly configured. When such a switch is configured and armed, the device will send email event notifications as scheduled and configured. When the switch is disarmed, the device will not send email event notifications even

if the schedule and configuration would otherwise send email notifications. Required settings include RS485 protocol, baud rate, and control ID. <http://www.techbis.pl/files/93-actra-integra-manual.xml>

Park Smithies Lane, Heckmondwike West Yorkshire WF16 0PN Park Smithies Lane, Heckmondwike, West Yorkshire WF16 0PN Sign up for newsletter today. Pay now with address and payment details stored in your Amazon account. This ongoing and concerted demonstration of excellence has all led to Concept 300. Build on the runaway success of the floorstanding Concept 500 and deliver a standmounting alternative that's at once more affordable, of utterly uncompromised performance and of stylish, understated elegance. We call these retailers the Q ELITE, many of which are centres of excellence for both Q Acoustics and sister brand QED and where you can be confident of receiving the ultimate Q Acoustics experience. Aesthetic considerations are perfectly valid and, to this end, in the Concept 300 Q Acoustics has designed a highend, highperformance loudspeaker that's unshowily sophisticated and able to interact discreetly with any interior design vocabulary. This results in a cabinet that manages to be clean and understated at the same time as being of obviously high perceived value. It's equipped for biwiring or biamping via its electrically isolated terminals these can accept bare wire, spade connectors or 4mm banana plugs. Of course, it's not possible to entirely rid a loudspeaker cabinet of unwanted vibrations that can interfere with its performance but, as Q Acoustics has demonstrated with Concept 300, it is possible to keep cabinet vibrations to an absolute minimum in order to deliver entirely uncorrupted sound. Q Acoustics is able to measure the performance of the cabinet structure at a microscopic level, and identifies the precise positions that require support. So the P2P targeted cabinetbracing method means the cabinet has exactly the support it needs, and no more. In this instance, a long and involved analysis of a problem results in a simple and brilliantly effective solution.

The Concept 300 cabinet is comprised of three individual layers, each separated by a nonsetting gel the gel acts rather like a hightech and extremely effective gasket. Any stray highfrequency vibrations are converted into heat which dissipates within the gel. And it's the design of the new Tensegrity stand, and the new isolation base suspension system that joins Concept 300 to it, that allows Q Acoustics to redefine the level of performance that's possible from a smaller loudspeaker. It's built from precision machined stainless steel rods which are the loadbearing element and thin stainless steel cables which maintain the position of the loadbearing rods. The result is an exceptionally rigid and selfsupporting structure with a remarkably low surface area and let's not pretend otherwise beautifully elegant appearance. It's not so much a speaker stand, it's more an entirely new loudspeaker support concept. Q Acoustics joins Concept 300 speaker to Tensegrity stand with the new isolation base suspension system, which is about as sympathetic and efficient as it gets. This isolation base system works in multiple ways it prevents energy from the speaker leaking into the Tensegrity stand and affecting the sound, it prevents vibrations for the floor making their way from the stands into the speaker, and in every circumstance it provides a rigid coupling between speaker and stand. The result is midrange and bass response that's as punchy and dynamic as it is poised and eloquent. This protects the tweeter from sending or receiving unwanted vibrations and allows it to be mounted close to the midbass driver. This improves integration with the larger driver and the very subtle hornshaped profile to the tweeter's front plate allows perfect impedancematching with its environment without colouring performance.

In combination with the equally meticulous Tensegrity stand, Concept 300 represents a stepchange in loudspeaker design and a redefinition of what is possible at its price. It has been over 14 years since Q Acoustics was founded, and in every year since we have continued to drive innovation and develop multiaward winning products. Bart Gadeyne Pieter Verhamme Abstract Neverending growth in worldwide maritime container transportation automatically entails several container terminal optimisation questions. In this master thesis, research on the topic of double cycling in the quay

crane scheduling problem QCSP is presented. Most papers concerning the QCSP neglect several operational issues, such as sequence constraints and spreader setup times. As a result, the related models lose grip with reality. This thesis clarifies important operational concerns and presents a QCSP model that incorporates the main operational constraints. The proposed heuristics are tested on real-life data and provide near-optimal solutions to the model within an acceptable time period. The presented hybrid genetic algorithm yields the best results and shows that double cycling can reduce vessel turnaround time by more or less 10%, depending on the given stowage plan. The financial impact of this reduction in vessel completion time is estimated in the last chapter.

Keywords double cycling; quay crane scheduling; terminal operations; genetic algorithm

Preface

Writing a thesis is not a piece of cake and certainly not when you have to write it together with your best friend. Besides some occasional moments of frustration, we had great fun when elaborating this master paper. However, with only having fun we would not have got very far. Hence we also would like to thank a few people who inspired us. First of all, we want to thank our promoter, Prof. Dr. Ir. B. Raa. Without him we could not have started this work in the first place. He also pushed us in the right direction when needed.

<http://drbillbaker.com/images/canon-30d-manual-sensor-cleaning.pdf>

Second, visiting the port of Antwerp and Zeebrugge brought us meaningful insights into the fascinating world of shipping in general, and more specifically into maritime container transportation. Therefore we would also like to thank Rowan Van Schaeren for the tour in the port of Antwerp and for supplying a number of important ideas and work items. Furthermore, we would like to express our gratitude to Philippe Wyngaert for the insightful roundtrip in the port of Zeebrugge and all provided information and documentation. Without him, it would not have been possible to understand several operational issues. We also want to thank the container terminal operator PSA Antwerp for their cooperation and for providing the necessary data for this master paper. In addition, many thanks go to Vincent Van Peteghem for his insights and suggestions regarding useful heuristic solution methods. We would also like to express our sincere thanks to Nathalie Demeyer and Mark Van Landschoot for reading through and correcting this thesis. Last but not least, we would like to acknowledge the role of our parents, family and friends for being a constant source of support and strength. We warmly appreciate their contribution.

Transshipment in northern Europe is forecasted to almost triple between 2001 and 2015, from 6.72 mio TEU to 17.1 mio TEU Baird, 2006. In short, ports have to deal with both more as well as bigger container vessels. With respect to this evolution, container terminals are assigned an increasingly important role as key hubs within the overall transportation network. There are several practical explanations for this. Large vessels tend to call at several ports in a multiport itinerary Baird, 2006. Consequently, retardation in one of the ports within the itinerary will cause a delay for the next ports. In addition, berth allocation possibilities for ports are limited. During peak periods this might cause vessels having to wait if turnaround times are rather high.

<http://gandgengineering.com/images/canon-30d-manual-online.pdf>

Obviously, this is an undesirable situation, and moreover, terminals can't fully control the inflow of vessels in the port. The explanations stated above are of course interrelated. On one hand, waiting in one port will cause delays for the next port. On the other hand, the incurred delays could also cause additional waiting time in the next port, just because the vessel did not berth at the anticipated point of time. The fact that the economies of scale of larger vessels can only be realized if the handling speed at the harbours increases accordingly, is stated by Meersmans and Dekker 2001 as well. In contrast to increasing capacity by terminal expansion or the acquisition of extra handling equipment, we will investigate the effects of applying double cycling strategies as a low-cost method to increase capacity. For a comprehensive overview of most of the operational research problems in container terminals, we refer to the surveys of Meersmans and Dekker 2001, Vis and de Koster 2003

and Stahlbock and Vo 2008. 1.2. Structure of this paper In the next chapter, a brief but fairly complete overview of basic container handling elements and activities is given. This overview is based on publicly available papers and our visit to the Port of Antwerp and the Port of Zeebrugge. This chapter provides information on both containers, container vessels, as well as container terminals and unloading practices. In addition, the problem definition of this paper is stated at the end of Chapter 2. While Chapter 2 mainly focuses on practical operational concerns, Chapter 3 mainly provides the theoretical background, by giving an overview of literature on operational research problems. Both container loading and unloading practices are discussed as well during this chapter, as well as the berth and quay crane allocation problem. Furthermore quay crane scheduling and crane efficiency will be reviewed along with some other smaller operational aspects.

Afterwards two mixed integer linear problem models are proposed in Chapter 4. The characteristics of the problem will be discussed, as well as the assumptions made. Eventually, two models are presented and elaborated into detail. Finally, a small comparison is made between both models. 2 Next to that the practical implementation of the problem instance is described in Chapter 5, together with the implemented heuristics. In this chapter, a greedy heuristic is presented, as well as a GRASP, intelligent constructive and extended intelligent constructive heuristic. Finally, a hybrid genetic algorithm is fully elaborated. The results of all heuristic methods mentioned above are compared to the current way of handling containers and an intermediate solution. The quay crane assignment method is briefly discussed as well, after which general results of the implemented solution methods are presented, based on 5 different data sets. Next, in Chapter 6 a sensitivity analysis is conducted, while Chapter 7 reviews the problem from an economic point of view. Basically, containers can be described as being large boxes, used to transport goods from one destination to another. Compared to conventional bulk, the use of containers has several advantages, including less product packaging, less product damage and higher productivity. This standardisation enables a uniform container handling, entailing large savings of time and money. The possible container lengths are listed below in Table 1. The possible container heights are listed in Table 2 Algemene Handleiding Bediende Containerterminals Versie 5.3, 2011. Notice that these are the minimum external dimensions of containers. The most widely used type of container is the general purpose Dry Van container, having an external length and 4 height of either 20' x 8'6", or 40' x 8'6" and 40' x 9'6". These so-called palletwide containers are specifically used for palletised cargo.

Similar to the container sizes, generic container types are standardized by the International Standards Organization. According to ISO 6346, containers are assigned a category name and identifier. A nonexhaustive overview of commonly used container types is listed in Annex 10.1. More information on the designations used can be found on the ISO website² or on the website of the Bureau International des Containers et du Transport Intermodal B.I.C.³ or in Annex 10.2. 2.2. Vessel layout Large container vessels typically hold up to 20 stacks FEUs⁴ of containers across the width of the ship, and up to 20 stacks along the length of the ship. A typical structure of a container vessel is depicted in Figure 1. 12 11 10 9 8 7 6 5 4 3 2 1 46 42 38 34 30 26 22 18 14 10 06 02 47 45 43 41 39 37 27 25 23 21 19 17 15 13 11 09 Hatch number Bay number 35 33 31 29 Figure 1 07 05 03 01 40ft Bay 20ft Bay Storage location structure of a vessel Container slot positions aboard a ship are expressed by three coordinates. The bay is specified first, then the container row, which is the coordinate along the width of the ship, and finally the tier vertical layer. The bayrowtier system is elaborated below. Bay Since a vessel can transport both 20ft as well as 40ft containers, the bay spaces for 20ft containers are numbered throughout fore to aft with odd numbers, i.e. in this case 01, 03, 05 and so on. The even number between two 20ft containers is thus used to define 40 bays, as can be seen in Figure 1. Row Vessel rows are numbered with even numbers from centreline to portside and with odd numbers from centreline to starboard, as can be seen in Figure 2. In ships where there is an odd numbering of rows, the middle row is numbered 00 GDV, 2011. Tier The

container tiers are numbered with even numbers, starting from the bottom. The conventional way is to start with 02 in the hold and then count up with 04, 06 etc.

In the case of deck cargoes, it is conventional to start numbering tiers above deck with 80, again followed by an even number sequence. This again can be seen in Figure 2. Tier 84 82 80 10 08 06 04 Quay Row Figure 2 02 10 08 06 04 02 01 03 05 07 09 Crosssectional view of a bay Vessels' above deck and below deck storage is often separated by hatch covers. These hatch covers are basically large steel plates. Although in theory it would be possible to lift only one part of the hatch cover and reach for containers beneath it, in practice this is rarely done Wyngaert, 2011. All models that do take hatch covers into account consider the hatch to be one part as well. Subsequently, precedence constraints are defined as follows. All the unloading activities below deck in the hold cannot begin until all unloading activities above deck are completed. All ondeck loading activities can't start until all belowdeck loading activities are completed. 6 Hatches change the nature of the problem, because the stacks cannot be handled without interruption. Below, a simple example is shown in Figure 3 to describe the characteristics of the problem. A B C F G J K Hatch covers D E H Hatch 1 I L Hatch 2 Figure 3 M N Hatch 3 Simple example of general stack positions Following the situation of hatch covers discussed above, we can describe some precedence constraints according to the 3 hatches as follows. In the berth area, quay cranes handle the containers from large container vessels. They consist of an open lattice, with a beam extending over the vessel. Quay cranes have a trolley and spreader which attach to the containers from the top, which then are moved by cables. Two common types of QCs are used, namely rail mounted quay cranes and rubber tire quay cranes. Once a container has been moved from the ship, they are usually stacked in the container yard.

While reach stackers only handle empty containers due to weight restrictions, straddle carriers are capable of driving over a stack of loaded containers 3 or 4 containers high, lift it up and move it around. The main drawback of using trailers or AGVs is that containers need to be handled a second time by stacking cranes to position them in or next to the stack. The stack in the yard is organized either into a block pattern, served by stacking cranes or into a pattern of stacked rows of containers, enabling SCs to drive over these rows. In the USA on the other hand, it is common to keep containers stored individually on the trailer, as there is often more space available than in Europe and Asia. Empty containers are always stacked into a block pattern, since reach stackers are not be able to drive over containers in order to pick them up. Finally, as for the inland transportation, a container terminal can have different interfaces. There are transfer points for trucks, as well as rail terminals, where containers are loaded onto or unloaded from trains and possible barge service centers. 2.4. Container lifting system As mentioned above, quay cranes use a spreader to pick up containers from the top. These spreaders have a locking mechanism at each corner that attaches to the four corners of the container. More information and key features of the Bromma shiptostore STS45E twinlift spreader can be found in Annex 10.3. Similarly, spreaders are being used on straddle carriers to attach containers. The locking system, called twist lock, consists of a male and female part. The female part is a standardized corner casting, fitted to the container itself, whereas the male component is the actual twist lock, fitted to the spreader. Likewise, stability of the container stacks on deck of the vessel is ensured using the semiautomatic twist locks of the container below or the twist locks of the hatch covers.

A visual representation and example of using twist locks can be found in Annex 10.4. 8 Spreaders are often equipped with flipper guides that center the spreader on the container. The use of flippers is explained in Figure 5. Additionally, these flipper guides can be used to speed up the unloading process, which will be described in section 2.5.2. Figure 5 The usage of flipper guides during container pickup A final thing to mention is that quay cranes are usually equipped with telescopic container spreaders, able to adjust its length to lift 20ft, 40ft and 45ft containers. All other systems,

such as SPACE5 or SHIPS6, connected with CTCS, can appeal to the latest information, thanks to one central database. In practice, rules of thumb are applied to determine a sequence of container movements that converts the arrival configuration of a bay into the departure configuration. Common rules are to clear a bay by unloading containers tier wise or stack wise, starting at the quayside and ending at the seaside of the vessel. These practices are explained below.

5 SPACE is an example of yard planning software, used for assigning the best possible stack position of a container, within the container yard, as well as retrieving those containers.

6 SHIPS software is used to prepare for unloading and loading the vessel, as well as vessel planning software.

6 Based on resulting bayplans, SHIPS assists terminal workers in determining the optimal crane work scenario with the best crane sequence.

2.5.1. Loading of a vessel

The loading of a vessel starts with the straddle carriers picking up the export containers from the container yard and delivering them to the apron. The SPACE yard planning software and yard transport software, for instance TRAFIC TRANSPORTER Flow Control, is used to guide SC drivers the specified stack position. This kind of software determines the most appropriate Move Instruction for a SC.

Once a container has been delivered to the apron, the quay crane can start loading it onto the vessel, in its predetermined container slot. As mentioned above, loading is often done in a tier wise order, starting at the seaside of the vessel and ending at the quayside. This way, the previous placed container can be used as a guidance to perfectly fit the container in place. The crane operator lets the container slide against the previous one, and afterwards the container can almost immediately be lowered and dropped to the right place. This whole concept is explained in Figure 6a.

After having placed container 1, container 2 and 3 can be loaded quite easily right next to each other. When finished with this tier, the next tier can be loaded similarly.

2.5.2. Unloading of a vessel

Unloading often happens by reversing the loading pattern, as can be seen in Figure 6b. Thus, unloading starts at the quayside and ends at the seaside of the vessel. Similarly to loading, the crane operator now uses the spreader's guidance flippers to slide against the container to be unloaded. This way, the spreader is correctly positioned on top of the container after which the containers are automatically locked on the spreader through the twist lock system. The quay crane can then deliver the container to the apron.

10 Depending on the type of container empty, import, transit, the unloaded container is then moved by a SC to a specific position in the container yard. In contrast, by alternating loading and unloading operations double cycling, the number of empty movements of the QC spreader is reduced and the service of a bay is accelerated. This concept is explained in Figure 10 page 23. Although the concept of double cycling might seem impeccable, double cycling entails quite a lot of practical concerns that are often not described in scientific literature. For the theoretical advantages of double cycling we refer to Section 3.

4 page 21. Practical restrictions are listed below, based on both literature, as well as on the conversations with Wyngaert 2011 First, although double cycling looks quite obvious, we must bear in mind that container handling requires quite some human input. Even though large parts of, for instance, yard planning, stowage planning and yard transport can be automated or ITsupported, container handling in essence remains a complex cooperation of the vessel dispatcher, crane operators, SC drivers, cargo inspectors, container markers. Consequently, all these people should receive training in the first place, in order to pick up a new way of working. Additionally, this productivity gain entails an increased workload and requires more concentration during work. Indeed, not only more containers can be handled, but both import as well as export containers are mixed and handled simultaneously. As a result, stress levels increase, leading to much more human errors compared to when using single cycling. Second, double cycling might require the use of additional handling equipment. Although double cycling could lead to a reduction in the number of landside vehicles on the one hand elaborated in section 3.4 and Figure 11 on page 24, the QC productivity gain would result in a double need for handling equipment according to Goodchild and

Daganzo 2007. This would result in an additional cost per container moved. Additionally, this situation would shift the bottleneck from the QC to the landside operations, which is not desirable due to a risk of yard traffic congestions. Third, in the current way of working, there is yet a software-related problem. Current software works with two different modes, that is either the loading or unloading mode. Consequently, double cycling would require continuous switching between both modes. However, this switchover is rather slow, resulting in an impractical way of working.

Consequently, double cycling would require an additional investment in new software, adjusted to the new way of working. Yet, double cycling holds a great potential, especially because no huge capital investments are required in comparison with other ways of increasing capacity or efficiency such as purchasing new quay cranes. In the next Chapter 3, we will dig deeper into these subjects. Basically, container terminal tasks include WAN, 2003. Berth allocation Yard planning Stowage planning Crane scheduling Logistics planning Among the logistic tasks, Stahlbock and Vo 2008 for instance include storage space allocation, assigning and coordinating quay cranes, yard cranes and prime movers. In a container terminal, these tasks are crucial since yard space and cranes are scarce resources. In this paper, we will mainly focus on the quay crane scheduling problem, considering other logistic activities as given. This problem can be split into two subproblems. First, specific quay cranes must be assigned to specific tasks a set of containers. Second, a detailed schedule of the loading and unloading moves for each quay crane should be constructed. In this case, the number of quay cranes assigned to the vessel is assumed to be known in advance. Although there is already quite some scientific literature on this subject, this paper aims at covering two big voids. First of all, most papers incorporate only few practical constraints applicable to the problem. For instance, to our knowledge, there is no model taking into account spreader setup times. Although modelling each and every constraint is obviously not possible, models are often overly theoretical. The proposed model in this paper intends to include as many practical constraints as possible, and go further than the common sequencerelated constraints. Secondly, many of the proposed solution methods only apply to smaller problem instances.