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Transit Care, an Opportunity for Multi-Function Tall Buildings

综合性高层建筑的交通解决方案

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John Mizon has been involved in the elevator industry for nearly 40 years. A Chartered Electrical Engineer, he has held positions of increasing responsibility in the areas of Operations, Marketing and Engineering with both Otis and then Schindler culminating in his current position of Vice President Advanced Programs. John is based at Schindler's advanced research group in Lucerne, Switzerland.

John Mizon在电梯行业从业近40年。作为一名注册电气工程师，他先后在奥的斯和迅达工作，并在这两家公司的运营、营销和设计部门担任越来越重要的职务，直至最后任迅达集团的新技术研发部副总裁。目前，John在位于瑞士卢塞恩的迅达集团新技术研发部工作。

Abstract

All tall buildings exhibit a degree of multi-functionalism whether it is simply, say, a cafeteria or trading floor within the context of one operation or a true multi-use construction incorporating apartments, a hotel and offices. The differing needs of the users of such buildings have tended to mean a duplication of vertical transportation solutions which can be ultimately ruinous to efficient operation.At the same time, as buildings continue to become substantially higher, a conventionally-operated elevator system is no longer able to cope requiring new approaches to be undertaken. The paper will review the holistic Transit Care approach to building vertical transportation and show how in multi-functional environments in particular and tall buildings in general, extremely favorable results can be obtained in the design of such systems and ultimately, of the buildings themselves.

Keywords: Elevator, Transit Care, PORT, Destination Control

摘要

在某种程度上，所有的高层建筑均为多功能建筑，这里所谓的多功能也许只是包括了企业的职工餐厅或交易大厅，然而，有的高层建筑也可能真正集公寓、酒店和写字楼等多种功能于一体。为了满足建筑物内各种用户的不同需求，往往需要在高层建筑内重复的叠加垂直交通系统。这最终导致垂直交通系统低效运行。另外，摩天大楼越建越高，传统的电梯调度系统已不能满足应用要求，因此，必须采用新的解决方案。本文评述Transit Care建筑物垂直交通管理系统，并说明在一般的高层建筑中尤其是在多功能建筑中应用这种管理系统以及最终改进建筑物的设计如何产生极大的效益。

关键词：电梯、Transit Care、个性化智能服务终端（PORT）、目的楼层控制

Introduction

We believe that the discipline of Transit Care is an essential design discipline for Tall Buildings if their full potential is to be realized. This is particularly true if they are part of a multi-function cluster either across a campus or integrated into one structure.

Transit Care is defined by an approach that, rather than looking at a mass of people who wish to move from one floor to another as a subtext of a larger building transit requirement, instead takes the responsibility for the entire journey from its inception to its conclusion and, by integrating all these journey's achieves a stepwise improvement in equipment utilization and, by extension, not only customer satisfaction but the very design possibilities of the building itself.

To successfully implement Transit Care it has been necessary to radically change the methodology by which the individual requiring transportation communicates their wishes to the system providing it. The key issue has been that the information content of the "requirement transaction" is significantly larger since the breadth of requirements to be addressed is much greater than before. This has led to the need for a new family of communication devices to be developed.

引言

我们认为，为了充分发挥高层建筑的潜力，在设计这些建筑物时，必须采用Transit Care垂直交通管理系统。在设计大学校园内的多功能建筑群或整体建筑物时，尤其必须应用或集成这样的系统。

Transit Care是一种建筑物垂直交通管理系统。从一个楼层到另一个楼层流动的人员多，并不代表建筑物内的交通需求大。Transit Care垂直交通管理系统为乘客提供从出发楼层至目的楼层的全程交通服务，并将用户的所有行程信息收集于管理系统中，然后，根据这些信息逐步提高电梯的利用率。这种系统不但能提高客户满意度，也允许建筑物有更多的设计方案。

为了成功地应用Transit Care系统，必须彻底改变乘客的呼梯方式。关键的问题是，乘梯需求涉及的范围比过去大得多，因此，“呼梯指令”包含的信息量大幅增加，这就需要开发新的通信设备。

迅达公司开发的通信设备称为个性化智能服务终端，即PORT终端。PORT终端拥有多种型号款式，但是，所有这些型号款式均具有相同的特征。在每一台PORT终端上，安装了与用户通信的视觉和语音通信系统，装备了读取用户身份信息和乘梯需求的射频系统（通常为集成式RFID读卡器）

The Schindler solution to this communication device is termed the Personal Occupant Requirements Terminal or PORT. There are a range of specific versions but all of them exhibit the same characteristics. Each has a visual and audio means of communication with a user, a radio frequency device (often an RFID-reader combination) is used to obtain user identity and requirements and a combination of the two systems allows specific requirements to be understood (see Figure 1).

There are a number of differences between this communication methodology and that associated with traditional control of transportation and access systems in a building. These are highlighted below.

Range of Choice

A traditional control system will typically present the user with a range that covers every transport possibility in the building. To simplify this somewhat this choice can be broken down into, say, a choice of zones and then transportation within that zone, however in a large building just working out the travel requirement from signage and entering it into the system can be an onerous task for the user. The PORT approach is to configure the screen in real time to suit the needs of the specific user. This can be undertaken in a number of ways. If the user has a card it can be used to communicate the set of destinations of interest in the building which can then be entered via a touch command. An even simpler methodology based on context can be used. If, for example, a company is renting four floors of a building and has access to two common areas then a user standing on one of the rented floors would have access to the other three and the common areas and these would be presented. Another approach is to optionally allow each PORT to determine user preference by, during each time slot of the day, gathering usage data such that a listing may be generated in order of historical preference at that moment in time whenever the PORT is used.

Call Entry

Naturally a touch screen provides a convenient form of entry in itself but there is an increasing trend today of groups being averse to touching a screen in common uses by the general public. PORT therefore allows a touch-less approach where a RFID card may be held in place while each floor is offered in turn. Once the required floor is highlighted the card is removed and the call registered.

Combination Transactions

It is particularly important in tall buildings, where very large population entry at the lobby must be handled with the greatest efficiency, that the security and elevator assignment activity is as efficient as possible. For certain types of lobby layout it is possible and highly desirable that these transactions are combined. PORT design facilitates integration into a barrier system allowing, if required, the Transit Care system itself to validate entry and combine opening the barrier with an elevator assignment based on the normal destination of the user. This "normal destination" can be changed further downstream at another PORT terminal if the user is on one occasion wishes to travel somewhere else but in practice, during building entry by the usual occupants, this requirement is rare.

Figure 1. A typical PORT device. (Source: Schindler Limited)
图1. 一种典型的PORT终端设备（出自：迅达有限公司）

。这两种系统相结合即可获取特定的乘梯需求(见图1）。

这种通信方式与建筑物内传统的交通控制和门禁系统通信方式具有许多不同之处。下面重点介绍它们之间的差别。

选择范围

在传统的控制系统中，用户的选择范围通常包括建筑物内所有可能的交通需求。为了简化控制系统，可以根据交通需求将建筑物分成若干个乘梯区，乘客选择乘梯区乘梯。然而，在一座大型建筑物内，看清楚指示牌上的乘梯须知并将乘梯需求输入控制系统，这对用户来说是一件非常麻烦的事。如果使用PORT终端，则可以实时调整显示屏的设置，使之适应特定用户的需求。显示屏的设置可以通过多种方式完成。拥有射频卡的用户可以通过此卡将该用户在大楼内的一组相关目标楼层显示在PORT终端的显示屏上，然后，该用户可以通过一个触摸指令输入目的楼层。用户甚至还可以通过一种基于特定条件的更简单方法选择目的楼层。例如，某公司共租用了大楼内的四个楼层，另外，该公司还被允许进入楼内其它两个楼层的公共区域，那么，当该公司的电梯用户在某一个租用楼层的候梯厅呼梯时，该用户被允许进入另外三个楼层和其它两个楼层的公共区域，这些楼层都将显示在PORT终端的触摸屏上。另外一种可选的方案是，每一台PORT终端被允许记录和显示用户乘梯偏好，即收集并记录用户在一天中每一个时段的乘梯信息。然后，每当该用户使用PORT终端时，该终端便可以及时地将用户在过去一天中此时段的一系列乘梯偏好依次显示。

输入呼梯指令

使用触摸屏输入呼梯指令自然非常方便。但是，现在的人们越来越不喜欢使用公共场合的触摸屏。因此，PORT提供了一种非接触式呼梯方式，用户可以将RFID卡（射频识别卡）放在靠近终端设备的某个位置，这时，在显示屏上轮流地显示出每一个楼层。当目的楼层亮显时，将卡移开，这时便输入了呼梯信号。

集成多种功能

在高层建筑内，当候梯厅内候梯的人员非常多时，必须最大限度提高电梯的运输效率，此时，既要门禁系统安全可靠，又要尽量提高电梯的调度效率。在某些具有特定结构的候梯厅内，可以按照所希望的那样将门禁系统与电梯调动系统整合在一起。PORT终端的外观设计可以使这种设备方便地集成于门禁系统中。必要时，Transit Care系统可以验证进入者的身份，然后，打开门禁系统，并按照用户通常的目的楼层指派电梯。有时，该用户可能

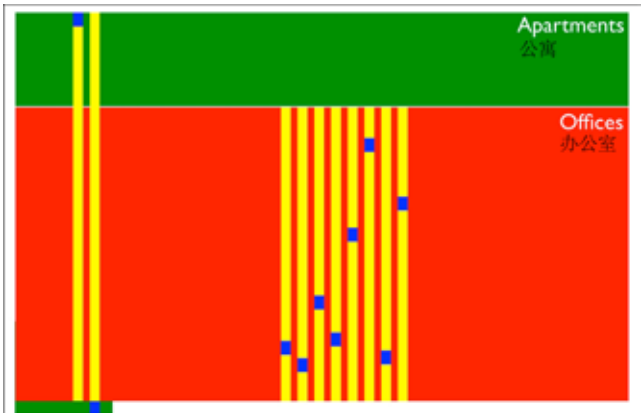

Figure 2. Sample conventional office/apartment configuration. (Source: Schindler Limited)
图2. 写字楼/公寓楼传统的电梯配置示例（出自：迅达有限公司）

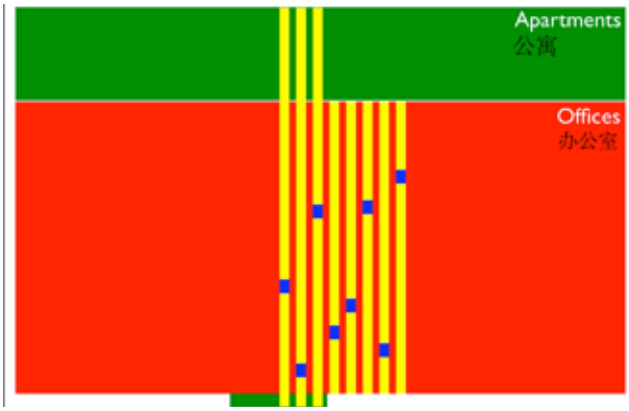

Figure 3. Sample Transit Care-based office/apartment configuration. (Source: Schindler Limited)
图3. 采用Transit Care系统时写字楼/公寓楼的电梯配置示例（出自：迅达有限公司）。

Position-relevant Transit

It is possible and desirable to configure PORTs so that the information that they give is always relevant and helpful. This means, for example, that if a user shows a card to a PORT whose main function is to control a set of elevators that the user would not require for transport to their destination, instead of an unhelpful error message, a guidance notice could be given to allow the user to find the transportation method they need. This notice could be highly specific or relatively general since the person using the system would know that, upon seeing another PORT, further information would be available.

Transit Care systems have been deployed around the world in both single-use and multi-function buildings. Among the building types to have been addressed are hotels, hospitals, offices and apartments. While in each instance the additional functionality that can be provided is important, the most interesting cases arise when a multi-functional building can have its vertical transportation system radically simplified by using this approach.

In order to illustrate the benefits that a Transit Care approach can provide let us consider the simplified case of an office building in a major city which includes on its topmost floors some very high end apartments. Normally, the high specification of the apartments' would require exclusive elevator service via a private entrance as illustrated in Figure 2.

The elevators, which are only used very rarely, would be utilizing an enormous amount of otherwise rentable space when the shaft area multiplied by the number of floors traversed is taken into account. They are, however, essential to the building design if a conventional elevator control system is used since they represent the only way in which the level of service that apartments of this nature require can be achieved.

If a Transit Care approach is taken, however, an arrangement as illustrated in Figure 3 is possible.

The office elevator and apartment elevator functions have been integrated by the simple expedient of extending three of the office elevators into the apartment zone. The elevators are using a "destination control" approach where passengers are assigned to cabins based on, among other things, their required destination, which they communicate prior to boarding. This means that which elevators are used for which tasks can be tightly controlled.

Consider what happens when a resident of the apartments returns home. Their arrival at the building is indicated by the use of either an auto ID tag, if they are arriving at a garage or an RFID device if they

要去其它楼层，这时，他可以在前面的另一台PORT终端上更改“通常的目的楼层”。但是，在进入大楼以后，用户通常不会改变目的楼层。

提高交通效率

用户可以按照自己的意愿设置PORT终端，使其只显示相关的和有用的信息。例如，如果一台PORT终端的主要功能是控制某组电梯，而这些电梯并不到达某用户的目的楼层，那么，当用户将射频卡靠近这台PORT终端时，显示屏上不会显示无用的出错信息，它可能会显示一条告示，指示用户找到需要的电梯。这条告示可能提供非常具体的内容，也可能只提供比较通用的信息，因为该系统的用户可能知道，附近的另一台PORT终端可能还会提供进一步的信息。

在世界各地的一些专用建筑物和多功能建筑物内已经部署了Transit Care系统。应用这种系统的建筑物包括酒店、医院、写字楼和公寓等。在每一项应用案例中，Transit Care系统都能提供非常重要的功能。但是，那些最引人注目的案例是，Transit Care系统在多功能建筑物中的应用可以彻底简化建筑物内的垂直交通系统。

为了说明Transit Care系统的优势，下面我们来分析一个简单的应用案例。某个大城市一幢写字楼的顶部若干个楼层为高档公寓。公寓的优质服务规范规定，在正常情况下，必须为住户提供专用电梯，住户从一个单独的入口乘梯，如图2所示。

将井道面积乘以电梯穿过的楼层数量后，就会发现那些使用率非常低的电梯占用了大量原本可以用于出租的楼层空间。然而，如果使用传统的电梯控制系统，则必须在建筑物的设计中采用这些电梯，因为这是保证高档公寓电梯服务级别的唯一方法。

但是，如果采用Transit Care系统，则可以设计如图3所示的电梯配置方案。

结果，可以将写字楼电梯和公寓电梯整合，只需将三台写字楼的电梯延伸至公寓区即可，这些电梯采用“目的楼层控制”策略。在进入轿厢之前，乘客先输入目标楼层信息。这时，电梯调度系统根据用户的目标楼层等信息为乘客分配轿厢。因此，可以严格控制各台电梯的运输任务。

下面是公寓内的住户回家时的乘梯经过。驾车到达车库的住户可以使用自动ID标签，步行到达大楼的住户可以使用RFID设备。住户通过这两种方式告知控制系统他们已经到达大楼。无论通过哪一种方式，住户均可以进入大楼并被指派一台电梯。这时，这台被指派的电梯不再接受办公楼层用户的呼梯信号，不再回答已从办公楼层发出的其余呼梯信号，以便空出电梯轿厢，使之为公寓的住户服务。为了避免派梯过程拖延的时间过长，可以调整办

are on foot. Either way access is granted and an elevator is assigned to them. At this point the assigned elevator will no longer accept calls from the office occupants and answer the remainder of its office calls in order to empty the cab for apartment service. To prevent this activity creating significant delays it is possible to adjust the office control so that one or two cabs are never more than, say, 30 seconds from being released without major impact on the office service. The freed car then heads for the private entrance and grants the resident an exclusive express ride to their apartment level. As soon as the resident leaves the cabin it can be returned to the group. From the perspective of the office system it has been out of service for a short period. This period does not represent the entire time while it was in use by the resident but only a portion of it. Once the resident journey is close enough to the end for allocations to be made in the office zone without excessive waits being generated then it has effectively re-entered the office group.

The result of this approach is that no wasted elevator shaft space is generated. The effect on office service by one of the elevators going on an apartment run is negligible especially when the fact that the office will probably not be running at peak traffic levels for much of the time these are needed. The resident perceives the level of service that they would expect for the price they are paying and this could be further enhanced by such items as a variation in the cabin ambient lighting and specific, residential-relevant messaging on, for example, the information screens. It should also be clear that there is a potential here to actually offer a better level of service than might be achievable with dedicated elevators especially during periods where office traffic is light. In addition the type of security and personal service often demanded by such apartments is obtained without additional cost when an installation of this nature is undertaken.

This simple example illustrates the many advantages that a Transit Care system can bring when it is included in the design of a building. The issue here, of course, is how the use of such an approach is designed in and how during this process the impact in terms of enhancing the design is assessed.

The elevator industry has traditionally relied on probabilistic calculations to determine at an early stage the magnitude of the installation required to meet certain traffic specifications and, more recently, these rough results have been further honed by simulations to ensure that specific floor placement choices (for example a cafeteria) were made correctly. It is important, however to ensure that the simulations which are undertaken are of a high quality. Dr. Lukas Finschi has pointed out the risks associated with an over-simplistic approach to building traffic simulation.

"Today, simulations are widely used for traffic analyses, as it has more generally been recognized that this is necessary. However, simulation methods are often very poorly applied. The main problem comes from the fact that results often completely lack statistical relevance – just not enough data points are being considered for evaluation. Although this problem is known for a long time in general and also specifically in the elevator industry, it is widely ignored…elevator group controls have a big impact on handling capacity and service quality. Therefore, a realistic traffic analysis must reflect the actual elevator group control: There is no other way as to run simulations which use the actual control algorithms of the elevator group. Furthermore, results of a traffic analysis must be reliable, which means that the results are reproducible and unbiased. Reproducibility is challenged by randomness, which is an important element in simulations. We will see that it is not so difficult to cope with this, once the problem is

公楼层的电梯控制系统，确保在很短的时间内（例如，在30秒以内）即空出一个或两个电梯轿厢，同时，又不会对办公楼层的电梯服务造成重大影响。然后，空出的轿厢进入住户专用电梯口，使住户乘专梯直达公寓楼层。当住户离开轿厢后，该轿厢返回至办公楼层的电梯组。从办公楼层电梯系统的角度来看，该系统只是在短时间内暂停了服务。暂停服务的时间并没有占据住户使用电梯的整个时间，而是仅占该时间的一部分。当住户快到达目的楼层时，如果此时将该轿厢指派至办公楼层而不会让乘客等待的时间太长，那么，该轿厢此时实际上已回到办公楼层的电梯组。

采用这种方案不浪费电梯井道占用空间。当一台办公楼层的电梯在运送公寓的住户时，这台电梯对办公楼层电梯服务质量的影响可以忽略不计，而且，住户的乘梯时间常常不是办公楼层电梯的高峰流量时间，这种影响尤其可以忽略。住户觉得他们享受到了在支付昂贵房价后预期的服务级别。其它方面的改善可能还增强这种体验，例如，轿厢内的照明明显改善，显示屏上显示与住宅相关的特定信息。另外，应当清楚地看到，这种电梯配置方案有可能真正提供比住户专用电梯更好的服务质量，在办公楼层的电梯流量小时尤其如此。此外，安装了这种管理系统以后，不增加额外费用即可满足这类公寓经常需求的保安服务和个性化服务标准。

上述的简单例子表明，如果在设计的建筑物中采用Transit Care系统，这种系统提供许多优势。现在的问题是，如何在设计的建筑物中应用这样的系统，以及在这一过程中如何评价这种系统对改进建筑物的设计所产生的影响。

在早期阶段，电梯工业采用的传统方法是，依据概率计算结果确定需要安装电梯的数量，以满足特定流量的要求。近年来，这些粗略的结果通过模拟进行了更精确的处理，从而能够为电梯正确地选择特定的停站楼层（例如，餐厅所在的楼层）。但是，确保模拟结果的高质量非常重要。Lukas Finschi博士指出，在模拟建筑物的电梯流量时，过于简单的模拟方法存在风险。

"现在，模拟方法广泛地应用于电梯流量分析，模拟的必要性获得了更普遍的认可。然而，模拟方法常常没有得到适当的应用。主要的问题在于，模拟的结果常常完全缺乏统计学意义，在评价时没有考虑足够多的数据点。这个问题虽然广泛存在了很长时间，并且在电梯业尤其普遍，但仍被广泛忽视。分组管理电梯对运输能力和服务质量具有重大影响。因此，在进行现实的流量分析时，必须反映实际的电梯分组控制情况。在进行模拟时，除了使用电梯组的实际控制算法外，没有其它的方法。因此，流量分析的结果必须具有可靠性，也就是说，这些结果具有重现性和无偏向性。数据的随机性增加重现性的难度，随机性是模拟方法中的一个重要要素。我们将会发现，一旦把问题了解清楚了，解决起来并不是如此困难。简而言之，必须采集足够多的样本数据，然后，取这些数据的平均值，以处理数据之间的偏差。Finschi（2010）。

在采用Transit Care系统时，为了改进建筑物的设计，或者，为了实施具有难度的设计方案，必须先进行大量的高质量模拟，在模拟时应考虑整个建筑物内的人流量，而不只是孤立地考虑某一组电梯的流量。这时，还必须考虑提供指南的可能性和乘客的体验，将这种系统纳入设计内容之中，确保建筑物内的电梯运行效率。目前，这类模拟程序包已投入使用。可以预料，在未来几年，当这种解决方案更加成熟之后，这些程序包将会更广泛地被推广应用。

总之，我们越来越清楚地看到，随着更多400米以上高层建筑的规设设计以及随着这些建筑物的规划用途更加多元化，Transit Care系统可以提供实际的利益，既可以避免过多电梯占用可出租的楼层面积，又可以达到要求的电梯服务级别。

understood. Simply speaking, the variation must be averaged out by considering a sufficiently large set of sample data points." Finschi (2010)

For a Transit Care installation that enhances or even makes possible a challenging design to be achieved, a significant amount of high quality simulation must be undertaken up front which looks at the total movement of people through the building and not one group of elevators in isolation. The potential for guidance and the passenger experience must be considered at this time to ensure that this is part of the design mix and that the building will work well. Such simulation packages are now in use and it is expected that they will become much more widely available in years to come as this approach becomes more established.

In conclusion it is becoming very clear that as many more buildings in the 400 meter and above category are being planned and their planned usage is becoming more diverse, a Transit Care approach can offer real benefits in terms of allowing the required service levels to be achieved without an unacceptable loss of rentable space.

References（参考书目）:

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