DRAFT: U-Parkit Report

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Part A - Automated Parking and U-Parkit: A Global Perspective

Over the past few decades as the global population has surged, scarcity of land has become an increasingly dominant issue in many parts of the world. From the perspective of the parking industry, this scarcity combined with an increase in the number of vehicles presents a unique opportunity. At the turn of the century, it was estimated that there were about 600 million vehicles being driven around the world – a number that is expected to double by 2030 according to some experts[1]. In the US, there are 107 million households, each with an average of 1.9 cars, trucks or sport utility vehicles and 1.8 drivers according to the Bureau of Transportation Statistics. That equals 204 million vehicles and 191 million drivers in the United States alone[2].

Innovation in parking is not a recent phenomenon. The first US mechanical garage was built in Cincinnati in 1932[3] and between the 50's and 60's there were hundreds of Mechanical Parking Systems (MPS) built in Europe, Asia and Japan. The move from mechanization to automation however did not happen until much later in the 20th century with the Germans leading the charge. The past decade has seen a great degree of activity in the Automated Parking Systems (AMPS) space with 40+ companies in existence claiming to have an automated solution to parking. Today, the automated parking industry is highly globalized and in this section we attempt to illustrate the extent of globalization within automated parking and more specifically assessing the degree of global competitiveness for the U-Parkit system.

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1 http://hypertextbook.com/facts/2001/MarinaStasenko.shtml (Accessed on January 28th, 2008)
2 Miller, Leslie. "Cars, trucks now outnumber drivers." Salon. August 29th, 2003.
3 http://www.robopark.com/product.html (Accessed on January 29th, 2008)

Industry Level Analysis: Degree of Globalization

We evaluate the degree of globalization by using Yip's radar framework[4]. This "radar" maps four dimensions that determine the level of global competition in an industry. The upper vertical dimension in this "radar" chart refers to **market conditions**, whether the market is effectively one or several geographically defined segments because of similarities/differences in tastes, requirements, channels, etc. The left horizontal dimension refers to various sources of increasing returns to **scale** in the production process. The right horizontal scale refers to the **comparative and/or competitive advantages of particular locations.** The lower vertical dimension refers to **regulatory interventions** that limit the geographic scope of the industry such as tariffs and non-tariff barriers to trade and limits on cross-border investment. The higher a market/industry falls on the scale of each of these dimensions, the more global that industry is.

- *Market Similarity* – We believe that the gap AMPS aim to fill exists across the globe. Asia, Europe, North and South America and the Middle East are all facing major parking challenges particularly in their busiest urban cities. This leads to the need to deploy unique solutions to park greater numbers of vehicles. AMPS provide just that solution. The challenges however can tend to vary based on which country we are dealing with , and as a result, most global firms with AMPS now have subsidiaries, licensees or offices in different parts of the world and are hiring local talent to cross cultural bridges.
- *Scale* – This industry is a great example of one that benefits from traditional economies of scale. The advantage is inherent with raw materials used in AMPS, particularly steel, but we can also expect to see scale benefits for the product as a whole. As demand for

[4] This simplified 4-D framework draws on the more extensive "Forces for Globalization and Local Responsiveness" (I-R grid) proposed by Prahalad and Doz.

AMPS grows, producers will be able to drive production costs down by manufacturing AMPS in larger quantities rather than the job-shop lot sizes that are more common today. Moreover, there is a learning curve in this industry, as a firm builds and installs more systems, they get better and better at handling the unexpected and building redundancies, which in turn leads to reduced costs for the firm and an improved bottom line. In addition, let's say a certain AMPS penetrates a particular industry like casinos - word travels fast and demand for a similar solution goes up dramatically within that industry. AMPS would be lower on the scale dimension than the commercial aircraft industry, for example, but definitely higher than a services-based industry like management consulting.

- *Comparative/Competitive Advantage* – Local or niche players definitely have an advantage in this industry as they have a stronger understanding of regional practices and local industry operations. They also have the ability to develop deeper relationships with their clients and government authorities. However, the industry as a whole has realized that the only way to stay in business is to take their product to the customer regardless of where the customer is located. This has caused a shift in the industry with most major players opening offices, subsidiaries or licensing agreements in different locations around the world. Thus, the automated parking industry is not affected dramatically by a comparative advantage of any single location per se, but firms who are able to form relationships at the local levels and meet localized needs are likely to enjoy a competitive advantage over other firms in this industry.
- *Regulation* – Regulatory barriers vary depending on the country/region in which the AMPS is to be installed. Before entering a new region, it is very important for a firm to understand which state/federal government authorities handle building codes and

requirements. The geographic scope for AMPS can be limited and it takes a lot of upfront investment and relationship building before a firm within this industry can operate across the globe. Figure 1 below presents a pictorial view of this discussion.

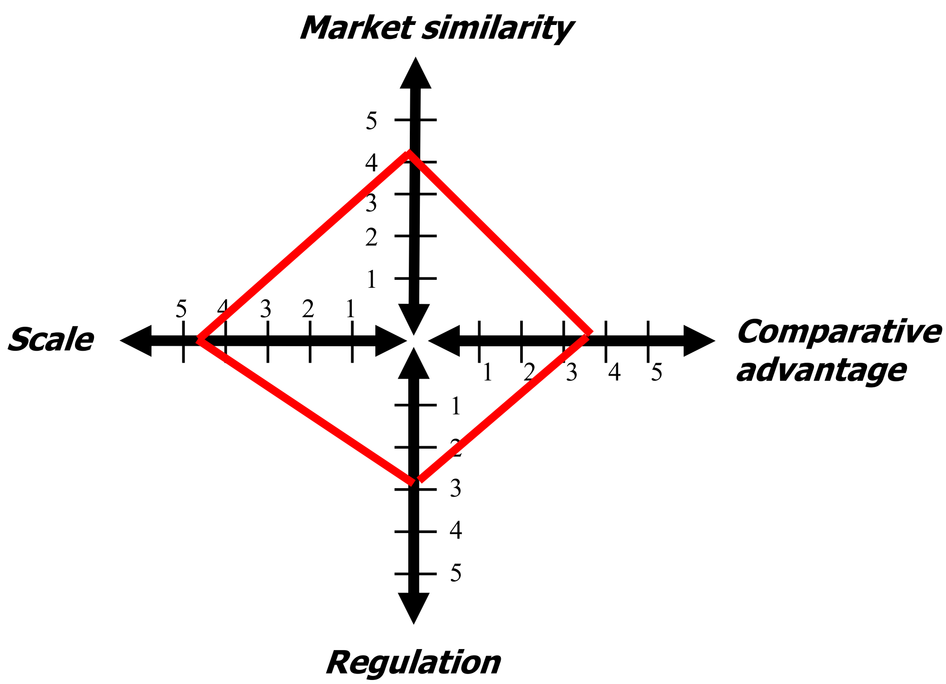

Figure 1: Global scope of industry (Yip)

Firm Level Analysis: Global or Not?

Michael Porter (1987) provides a useful two-dimensional framework in which he categorizes internationalization as involving configuration - where and at what scale are primary activities conducted; and coordination - to what extent and how are activities coordinated, knowledge shared, etc.

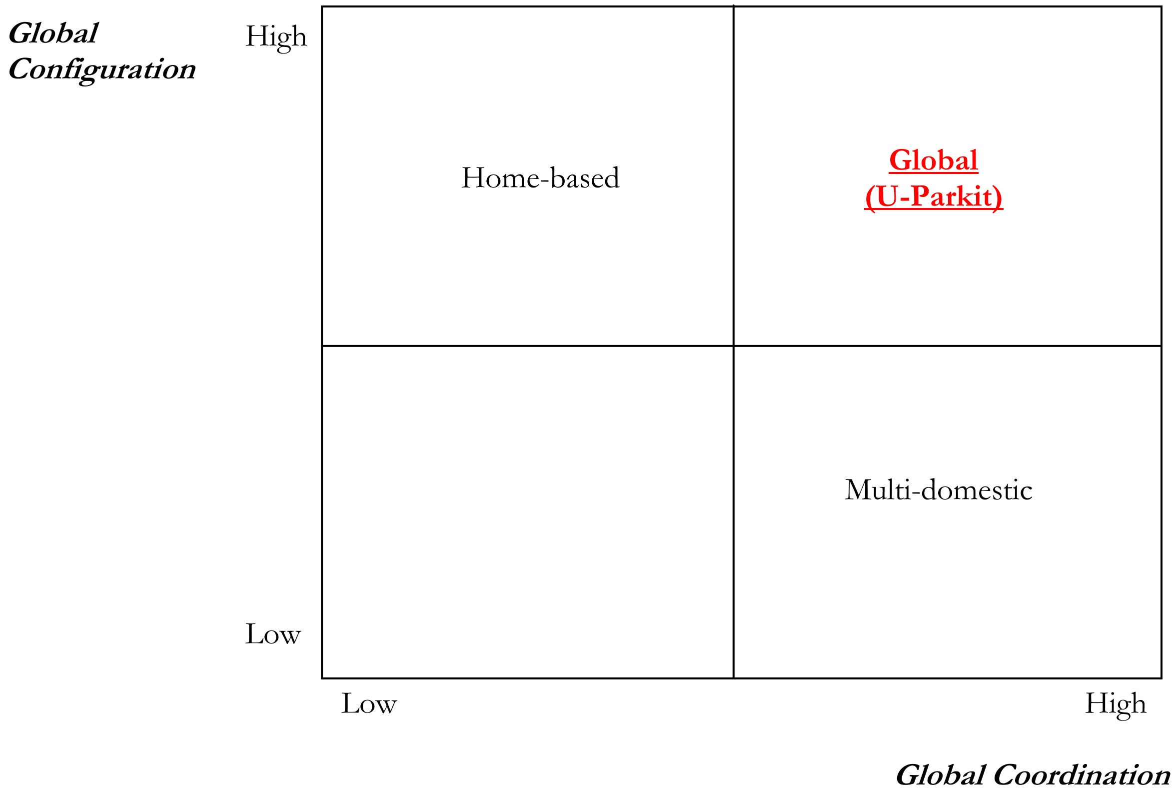

Figure 2: International Configuration/Coordination (Porter)

Using Porter's International Configuration/Coordination framework, we see that U-Parkit truly falls within the "Global" quadrant. When we look at global configuration, it is evident that though U-Parkit is headquartered in Auckland, New Zealand and has a majority of its employees based within the "home base", a large source of its revenues is from sales and installations of the system outside New Zealand. Primary activities for a firm like U-Parkit include R&D, manufacturing and regional sales and marketing for their AMPS. U-Parkit has licensees and customers all over the world including North America, Australia and Africa hence, global configuration is definitely high. The other axis is global coordination (i.e. to what extent and how are activities coordinated and knowledge shared etc.). Here again U-Parkit scores high because their current model is that their manufacturing is centralized but marketing and sales are decentralized through licensing agreements in different parts of the world. The "powerhouse" is still very much housed in Auckland however, and though the licensees control the identification of potential clients of AMPS in their regions, the final sales process is conducted by the senior management in Auckland.

Firm Level Analysis: U-Parkit's Global Reach

Moving on to map the global reach of U-Parkit (i.e. exactly how global is U-Parkit); we can use an additional framework that assesses the market spread, configuration, connectedness and localization. Market spread refers to the geographic scope of the firm's sales, ranging from local, through regional or continental, to global. Configuration of core activities refers to the geographic focus of key activities, whether they are locally focused, continentally focused, or globally focused. Connectedness refers both to coordination in the traditional sense and to sharing joint development of know-how. Localization refers to the degree of responsiveness to and/or embeddedness in various local environments. It involves much more than just tailoring products to the market. It is useful to think of at least five levels, ranging from the most superficial to the deepest: sufficiently localized **not to offend**; sufficiently localized to **sell** home based products and services effectively**;** sufficiently localized to **adapt** home based products and services to local environment; sufficiently localized to **develop** international products based on local conditions and sufficiently localized to **influence the rules** of the game in local environments.

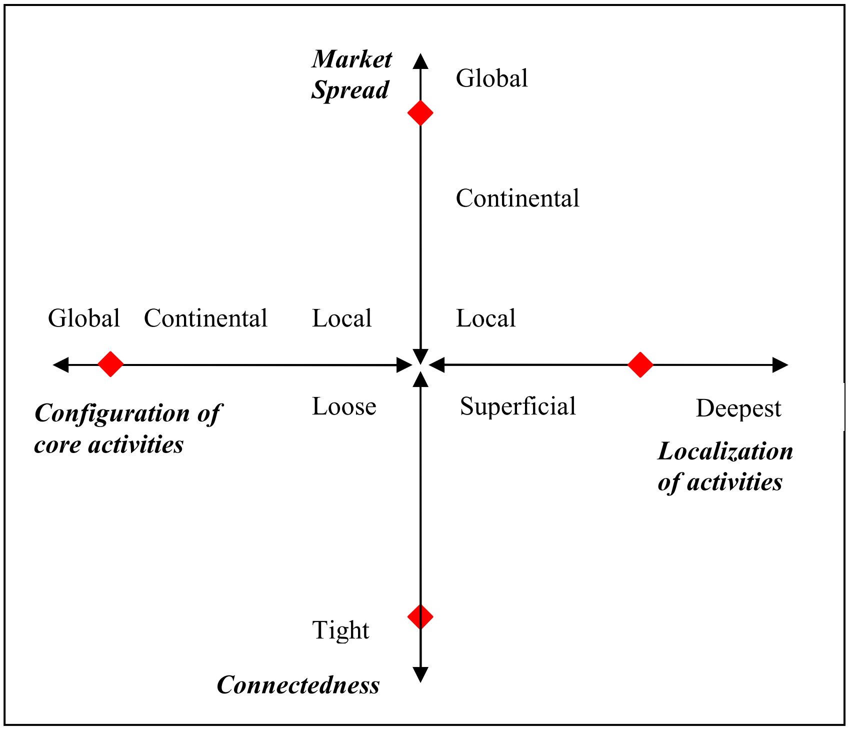

Figure 3: Mapping the global reach of the firm (Lessard)

- *Market Spread* - On a scale of local, continental and global, U-Parkit's sales come from many different countries on different continents so the market spread is global.
- *Configuration* – U-Parkit's core activities include R&D, manufacturing and sales and marketing of their AMPS. The R&D is currently happening within New Zealand and will be kept in-house in New Zealand in the future. Manufacturing is currently done in New Zealand but plans are in place to move manufacturing closer to clients in countries like India, South Africa and parts of Central and South America. Sales and Marketing are already happening at licensee sites around the world. High-potential customers are identified by U-Parkit's licensees and the sales cycle is then conducted with the joint involvement of the senior marketing team in New Zealand along with the local licensee's team. Hence, the configuration is also global.

- *Connectedness* – As in the previous framework, the connectedness on a scale of loose to tight is definitely as high as it gets for U-Parkit, given that there is a high degree of knowledge and best practices sharing. The team in New Zealand has to sign off on every proposal going out to clients regardless of where they are in the world. This ensures consistency in the message that is put out to the market about U-Parkit.
- *Localization* – U-Parkit is sufficiently localized to adapt its home-based product, (i.e. the U-Parkit AMPS) to local environments. The building codes in Ismailia, Egypt are different from those in Brisbane, Australia but both have the same U-Parkit system slightly adapted to conform to local requirements.

In summary, not only is the automated parking industry becoming increasingly global, U-Parkit has established itself as a uniquely qualified firm with a wide global reach within this industry.

Part B - U-Parkit: A Product Perspective

Section I – Traditional Concrete vs. Automated Parking Systems

The purpose of this section is to examine the tradeoffs between traditional concrete structure multi-level car parks versus automated car parking systems (AMPS) and to determine whether there is a meaningful value proposition for AMPS over the prevailing traditional solution. To determine this, we examine the two solutions by evaluating and comparing them along several dimensions of interest. These dimensions are:

1. Perception – What is the prevailing perception around each solution?
2. Cost – What are the primary cost drivers? How do the two solutions compare in terms of fixed, variable and total cost of ownership?
3. Quality/ Reliability/ Durability/ Safety – How do the two solutions compare in these areas?
4. Maintenance Requirement – How much maintenance does each solution require?
5. Environmental Impact – What impact does each solution have on the environment?
6. Efficiency – How do the two solutions compare in terms of efficiency of resources such as space, energy, revenue, etc?
7. Flexibility/ Scalability – To what extent is each of the solutions able to meet differing layout requirements, accommodate further expansion, relocation, etc?
8. Usability/ Convenience – How do the two options compare in terms of ease of use and convenience?

While the precise differences between the two options vary depending on factors such as location, size and product technology, here we evaluate the two options at a high, generalized level. Our findings are summarized in the table below:

Dimension	Traditional (Concrete)	Automated (AMPS)
1. Perception	Unattractive and "necessary evils," yet proven, simple, low-risk and widely-accepted solution	Pricey and not cost efficient, esoteric and complicated, unsafe, unproven and potentially risky solution
2. Cost	High fixed, high variable (see model in Table 3). Greatest cost drivers are construction, labor, security, HVAC and maintenance	High fixed, low variable (see model). Greatest cost drivers are initial construction and maintenance
3. Quality/ Reliability/ Durability/ Safety	General high degree of comfort around concrete structures. Established standards for concrete constructions, and little to no publicized evidence of past catastrophic parking lot failures	No established/comparable standards. Prior highly-publicized failures (Hoboken, NJ) have tarnished reliability, image and given a negative perception of quality/safety. Concerns about ability to withstand forces of nature (earthquakes, hurricanes, etc)
4. Maintenance Requirement	Require regular monitoring and servicing of lighting, security and HVAC systems, elevators, signage, painting, cleaning, and structural upkeep	Typically involves servicing of motors and/or hydraulic drives, chains, belts, pulleys, emergency systems, etc. (depending on product). Do not require lighting, HVAC, elevator servicing, signage, etc
5. Environmental Impact	Various systems (lighting, HVAC, security, elevators, etc) consume a lot of energy. Emissions from vehicles driving around ramps, waiting in queue, etc also contribute significantly to overall environmental footprint	Lower energy consumption due to little to no requirements for lighting, HVAC, etc, and lower emissions from vehicles which are typically not running inside the structure enable much smaller environmental footprint
6. Efficiency	Large footprint, additional space is required for turning radii, ramps, stairwells, ventilation, etc	Require less space to park same number of cars. Open up space for use towards greater revenue generating purposes

		(e.g. additional hotels rooms, apartments, shops)
7. Flexibility/ Scalability	Typically dedicated, inflexible structures that cannot be scaled, ported or altered in any way without significant reconstruction	Product dependent, but overall greater flexibility in terms of layout, and scalability. Some products allow for very high levels of modularity and portability
8. Usability/ Convenience	Patrons typically must enter the structure and drive around to determine availability and locate an available parking spot, then walk to their destinations	Patrons do not drive around; availability is typically known upfront and vehicles are parked in available cells automatically

Table 1: Traditional Concrete vs. Automated Parking Systems

In summary, there are very compelling arguments in support of AMPS over traditional concrete solutions. Specifically, the greatest advantages of AMPS over concrete structures are in the areas of maintenance, environmental impact, efficiency, flexibility, scalability and usability. Presently, AMPS' greatest challenges are overcoming the prevailing negative perceptions associated with them and proving their viability (in terms of reliability, cost and safety) as an alternative to traditional parking structures.

Section II – Brief Analysis of the Competitive Landscape

Having established a clear value proposition for AMPS over traditional parking structures, we now narrow our focus on the AMPS competitive landscape. Herein we map U-Parkit and its main competitors to the type of technology they employ in their products. The table below maps the various technologies discussed above to the specific key competitors that use those technologies in one or more of their products:

AMPS Company	Stackers	Rotary Lifts	Puzzle Parking	Circular Tower	Pallet s System	Comb / Scissor System	Rack System	Robotic System
Wohr				x	x	x	x	
Klaus	x				x		x	
M.P. System				x				x
Swiss Park	x	x	x		x		x	
Hercules	x	x				x		
Trevipark		x						
Westfalia					x			
Sotar					x			
Eltodo E.G.				x	x			
U-Parkit							x	

Table 2: U-Parkit, their Competitors and their Technologies

The above list of companies is not meant to be exhaustive, but is meant to provide a sense for who the primary competitors to U-Parkit are, and the various technologies they presently employ in their products. Based on our analysis of the competitive landscape we find that the U-Parkit solution currently occupies a somewhat unique position in the AMPS product space. The features that most distinguish the U-Parkit system and afford it its uniqueness are modularity, portability, overall simplicity and low environmental impact.

With the above advantages notwithstanding, there are competitive solutions (offered by Wohr, M.P. System, and Swiss Park for instance) with elements that are quite similar to the U-Parkit solution. Moreover, given the highly simplistic nature of the U-Parkit solution, despite IP protection, it could be easy for competitors to reverse-engineer and emulate the elements of the U-Parkit solution that currently give it a competitive advantage. We expect this will come to pass as U-Parkit continues to grow and achieve prominence on a global scale. Thus, we feel that at a product level, U-Parkit currently maintains a delicate advantage over its rivals.

Section III – Analysis of the U-Parkit AMPS Solution

Having established the advantages of AMPS over traditional concrete car parks, and briefly examined the competitive offerings in this space, we now explore the U-Parkit solution in greater detail by evaluating it against certain specific features that are of particular interest to us. These features are modularity, portability, simplicity and environmental impact.

Modularity

Our interest in modularity is driven by our belief that since accurately forecasting precise parking needs in the future is very difficult, the best AMPS solutions will be flexible enough to scale with changing demand conditions. The U-Parkit system achieves this by employing a "mechano set-like" design approach; U-Parkit parking cells are built to specific dimensions and are available in kitted sets. Additionally, the uniform 7-foot steel column lengths, pre-fabricated alignment holes and bolt-on connections (there are only a minimal number of welds throughout the system) combine to make it relatively easy to add or remove cells as needed.

Portability

In keeping with our aforementioned interest in modularity, we believe that cities and communities are continuously evolving entities and as the needs and layout of a town or city changes, the most promising AMPS solutions will in fact be enablers of that evolution rather than impediments. To that end, our finding is that the U-Parkit system is unique in that it has been designed with portability in mind, which allows the entire structure to be dismantled and relocated without tremendous effort. For example, in Auckland, a builder has plans to erect a building on land currently leased to a surface car park. Prior to the construction of the building, the U-Parkit system is an ideal fit to improve the parking situation in the Auckland Central Business District (CBD), without erecting a permanent parking structure. When the builder starts excavation for construction of the new building, the U-Parkit system may then be moved to a new site or incorporated into the building. From our examination of the industry at the time of this study, we were unable to find evidence of similar levels of portability among U-Parkit's competitive offerings.

Simplicity

In determining simplicity, we evaluated both the system design as well as convenience of maintenance and ease of use. Having observed the U-Parkit system in operation and studied the technical data, we found the design of the system to be alarmingly simple – there is a total absence of complex machinery or components, and the process of parking and retrieving a car is very straightforward and devoid of unnecessary movements or steps.

Nearly all the raw materials and components required to construct the U-Parkit product are non-proprietary and are available off-the-shelf, which again has important implications in regards to overall cost, maintenance and availability. Furthermore, in regards to maintenance, at the time of this report, we found that U-Parkit was the only company to offer a 2-year free of charge maintenance and service agreement with their product versus the more traditional 1-year term offered by most of their competitors. Finally, we found the U-Parkit system to be highly intuitive and user friendly. Minimal effort is required on the part of users beyond driving their car into the loading cell, and swiping their card or taking a ticket. The rest is done automatically, and there are numerous sensors and computer (PLC) logic built in for checks and balances. For example, there are sensors in place to check for acceptable vehicle dimensions and proper alignment when a car pulls in; the system will also check to verify that a cell is in fact empty before loading a vehicle into that cell.

Environmental Impact

Our criterion for assessing environmental impact is to consider the efficiency of the AMPS solution in terms of both footprint (space) and resource consumption (energy). In both these areas the U-Parkit system shines. In terms of footprint, the U-Parkit system can park the same number of cars as a traditional lot in only 40% of the space. It is able to achieve this because in the U-Parkit system a car is parked in a 229 square foot area as compared to the 315 square foot area required in a traditional lot (a 27% reduction in space used). Furthermore, by eliminating a lot of the clearance, ducting, ramps, walkways, stairwells, elevator shafts, bulkheads and other space-consuming features required in a traditional concrete structure, the U-Parkit system is highly space efficient.

In terms of resource consumption, the U-Parkit system employs electromechanical motors, which gives it a huge advantage over competitive systems that run on hydraulics. Electromechanical motors are significantly more energy efficient than hydraulics; this was thoroughly established in a new survey of industrial energy consumption carried out by the Delegation of Energy Supply in Southern Sweden (DESS) where it was determined that a saving of up to 90% could be made in electrical power consumption by using electromechanical solutions rather than hydraulics[5]. Other drawbacks of hydraulic systems

[5] http://www.engineeringtalk.com/news/tho/tho123.html, accessed Jan 29, 2008

vis-à-vis electromechanical motors are greater heat generation, higher emissions of hazardous airborne oil particles, greater noise in operation, higher risk of valve failure and greater wear on parts. In our examination of the competitive landscape, we found many of U-Parkit's competitors were in fact using hydraulics as part of their AMPS products.

In addition to low energy requirements, U-Parkit's unique fluid and runoff management system ensures that all fluids and effluents that drip from parked vehicles are safely collected by special absorbent strips that serve two purposes. Firstly, they ensure that runoff from one vehicle does not spill onto other vehicles, and second that any hazardous materials are safely collected and disposed of, further enabling them to reduce the overall environmental impact of their product.

Section IV – Product Risks and Concerns

In this section we present some of the key risks and challenges (from a product perspective) that we believe U-Parkit will likely need to contend with in the not too distant future.

- *Being Copied:* As we alluded to earlier, the simplicity of the U-Parkit design can be somewhat of a double-edged sword. Competitors are likely to notice U-Parkit's rapid growth and success and could potentially seek to imitate the U-Parkit product which could have a negative or dilutive effect on U-Parkit perception, brand and sales. Presently, we recommend the company pursue a two-pronged strategy to keep this risk in check: velocity and IP protection. We recommend the company maintain it's velocity in growing and securing "beachhead" or "gateway" contracts that effectively give them a first-mover advantage and make them the AMPS supplier of choice across the globe. Secondly, U-Parkit should maintain the highest level of IP protection it can afford to discourage blatant copying and infringement. These strategies will be critical in mitigating the effects of competitive reverse engineering and imitation.

- *Remote Monitoring:* Several of U-Parkit's clients have requested CCTV for monitoring and security purposes. While ordinarily this would not present a problem, the issue here is that in most countries it is illegal to monitor or capture license plates on CCTV. Thus, a solution is required that will enable vehicle monitoring without allowing identification of license plates. Presently the company has not identified a solution but is exploring options. One suggestion we have made is to position cameras to monitor the parked vehicles from above; this would allow a patron to view their vehicle while protecting the license plates from being viewed.
- *Belt Slippage:* While observing the prototype U-Parkit system in operation we noticed that some of the conveyor belts would occasionally slip. This was due to expansion of the nylon connector pins that hold sections of the plastic track together and occurs over time with use. This causes slack in the belts and could keep the system from functioning optimally. Currently, the company's mitigation plan is to address this issue as it occurs during quarterly maintenance visits. We suggest laying additional emphasis on belt slippage at the R&D stage and maintaining a proactive approach to changing belts that are not functioning optimally.
- *Exotic and Specialty Vehicles:* The U-Parkit system is designed to accommodate the majority of vehicles, but cannot accommodate some exotic, custom and luxury cars due to either their dimensions or clearances. The company maintains that by following legal specifications and requirements it is capturing the bulk of the market, however, concern

remains that they might be alienating or ignoring the high net worth, high willingness to pay clients who drive exotic vehicles. Recently, a few cells have been redesigned to accommodate larger SUVs (such as the Hummer) and the company is evaluating options for exotic cars as well. In addition, the U-Parkit system is not able to handle tiny vehicles, such as the Tata Nano, which is being released in India. The U-Parkit system is ideal for areas with major traffic and parking congestion; however, this limitation will greatly inhibit them from entering this segment of the market and is one that should be kept into consideration for future product iterations.

Section V – Operating and Maintenance Costs

We constructed a simple financial model to analyze the construction, operation and maintenance costs of surface lots, traditional concrete car parks and the U-Parkit AMPS. Based on our assumptions and calculations, the U-Parkit AMPS is significantly less costly on a per cell basis. The model illustrates that the total construction cost per cell or "bay" is lower for the automated system than both the surface lot and the traditional concrete car park. The surface lot cost is higher than the traditional concrete car park primarily due to the greater amount of land required for parking the same number of cars. The annual operations and maintenance costs for the surface lot are considerably lower than the traditional concrete car park and AMPS due to the simplistic nature of a surface lot. The AMPS' maintenance and operations costs are significantly lower than a traditional concrete car park because of the need for additional employees, lighting, ventilation systems, elevators etc. in a traditional car park. Table 3 below depicts the model findings based on a car park with 100 spaces.

	SURFACE	TRADITIONAL	AUTOMATED
Construction			
Parking Area Required (sq. ft)	31,500	31,500	22,873
Land for Parking Structure (sq. ft)	31,500	7,875	5,718
Land Cost	$2,992,500	$748,125	$543,234
Construction Cost	$500,000	$2,250,000	$2,000,000
Hard Costs (Land + Construction)	$3,492,500	$2,998,125	$2,543,234
Construction Financing	$55,000	$247,500	$220,000
Total Cost	$3,547,500	$3,245,625	$2,763,234
Total Cost Construction / Space	$35,475	$32,456	$27,632
Operation and Maintenance			
Total Annual O&M Cost / Space	$200	$800	$280
Total Annual Cost / Space	**$ 4,655**	**$ 4,876**	**$ 3,750**
Monthly Cost / Space	$387.90	$406.31	$312.50
Daily Cost / Space	$12.74	$13.35	$10.27
Daily Cost / Car	$10.48	$10.98	$8.45

Table 3: Model of Construction, Operation and Maintenance Costs

The model is based on assumptions (Appendix A) from findings on existing surface and traditional concrete car parks, as well as documentation on the U-Parkit system and conversations with the U-Parkit management team. The definitions for the terms in the model are indicated in Appendix B.

Section VI – Building Code Requirements

The U-Parkit system must adhere to International Building Standard Codes in order to move into any new market. Within the US market for example, county and city building codes may be unique across areas due to modifications made at the local level. In order to install a U-Parkit system in a US city, all building codes must be checked at the local level to ensure that the system is in compliance with the standards established in that area. If the system will cross a city, county or state border, then U-Parkit should seek legal council to establish building code compliance criteria for the particular situation. In addition to complying with building codes, U-Parkit also needs to comply with zoning requirements. In certain cases, a petition to the city for a "variance" clearance may be required if the zoning permit in place does not allow for such a structure to be built at the particular site. Also, the U-Parkit system may be subject to a review or traffic study.

Conclusion

The team compared automated car parking systems to traditional concrete car parks, the U-Parkit system to its competitors as well as the economic impacts of a U-Parkit system to a traditional concrete car park and surface lot. The results of our analysis showed that the AMPS system has significant advantages over concrete structures in the areas of maintenance, environmental impact, efficiency, flexibility, scalability and usability. Our model demonstrated that the AMPS' maintenance and operations costs are significantly lower than a traditional concrete car park because of the need for additional employees, lighting, ventilation systems, elevators etc. in a traditional car park, making them a cost effective alternative to a traditional concrete car park.

In addition, when comparing the U-Parkit system to its competitors, we have shown that the U-Parkit AMPS system currently has a competitive advantage through its distinguishing features of modularity, portability, simplicity and environmental friendliness. U-Parkit is a globally competitive system with a high degree of simplicity that must spread throughout the market quickly in order to not lose its competitive advantage.

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Appendix A: Assumptions

Assumptions	
Car Park Spaces	100
Cars Parking in a Space Per Day [6]	1.43
Occupancy Target	85%
Cost of land (per sq. ft.) [7]	$95
Surface Lot Construction Cost per Space [8]	$5,000
Traditional Car Park Construction Cost per Space [9]	$22,500
Automated Car Park Construction Cost per Space [10]	$20,000
Square Feet per Space - Traditional and Surface [11]	315
Square Feet per Space - Automated [12]	229
Construction Financing Cost	11%
Years of Payment	20
Traditional and Automated Car Park Stories	4
Annual Operations and Maintenance (per space) - Surface [13]	$200
Annual Operations and Maintenance (per space) - Traditional [14]	$800
Annual Operations (per space) - Automated [15]	$150
Annual Maintenance (per space) - Automated [16]	$130
Days per Year	365.25
Cars Parked Per Day	121.6

[6] http://ecenter.colorado.edu/greening_cu/2002/page3.html (Assessed January 27, 2008).
[7] http://www.nonprofithousing.org/actioncenter/toolbox/parking/costs_analysis.html (Assessed January 27, 2008).
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[16] U-Parkit Documentation and conversations with Gareth Jones

Appendix B: Definitions

Term	Definition
Annual Operations (per space) - Automated [17]	Yearly Salary for 1 employee @ $15K / Car Park Spaces
Annual Maintenance (per space) - Automated [18]	$2.50 per day * 52 weeks
Cars Parked Per Day	Car Park Spaces * Occupancy Target * Cars Parking in a Space Per Day
Parking Area Required (sq. ft)	Parking Spaces * Sq. ft. per Parking Space
Land for Parking Structure (sq. ft)	Size of Structure / Number of Stories
Land Cost	Land for Parking Structure * Land Cost per Sq. Ft
Construction Cost	Car Park Spaces * Cost per Space
Hard Costs (Land + Construction)	Land Cost + Construction Cost
Construction Financing	Hard Costs * Construction Financing Cost
Total Cost	Hard Costs + Financing
Total Cost Construction / Space	Total Cost / Number of Parking Spaces
Total Annual O&M Cost / Space	Annual Operations and Maintenance Costs
Total Annual Cost / Space	Annual Payment of Construction and Financing Costs over 20 years + Annual O&M Costs per Space **For Automated U-Parkit System, subtract annual maintenance costs for first 2 years
Monthly Cost / Space	Total Annual Cost per Space over 20 years / 12 Months
Daily Cost / Space	Total Annual Cost per Space over 20 years / Number of Days in Year
Daily Cost / Car	Daily Cost per Space over 20 years * 100 / Cars Parked Per Day

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Authors

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Tania Aidrus is currently pursuing an MBA from the MIT Sloan School of Management in Cambridge, Massachusetts. Tania has spent over four years in various strategy consulting assignments at Booz Allen Hamilton and First Consulting Group serving a range of public and private sector clients. She recently completed her summer internship at Google, Inc. in their Online Sales and Operations Group in Mountain View, California and Hyderabad, India and is planning to return to Google full-time in the fall of 2008.

Tania holds a Bachelor of Science in Biology and Economics from Brandeis University in Waltham, Massachusetts where she was a Presidential Scholar. She recently organized the MIT Sloan Dubai Trek where she led a group of 30 students to the UAE to understand their business environment. Tania has served on the Executive Committee of the Organization of Pakistani Entrepreneurs of North America (OPEN) where she helped start the Washington, DC chapter. She was most recently involved in running a Business Acceleration Plan Competition in Karachi, Pakistan aimed at promoting entrepreneurship in the region.

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Kristen Oldenburger is a 2008 MBA candidate at the MIT Sloan School of Management where she is focusing on finance, entrepreneurship and airline management. While at MIT Sloan, Kristen received the John Jamerson Fellowship and she was selected to do research in the UAE and India for a business case on start-up airlines.

Kristen recently completed her summer internship experience working in Investment Banking at Morgan Stanley in New York, New York. Prior to school, Kristen was the website project manager at Virgin America during their start-up period where she designed and managed their website development. She also has experience as a business analyst in internet distribution at Independence Air and in consulting for the aviation and space team at Booz Allen Hamilton. Kristen has a BSE in Interdisciplinary Engineering and a MS in Industrial Engineering from Purdue University.

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Sharad's primary areas of experience are in the consumer electronics, energy, and management consulting industries. He has worked for General Electric Co., Dell Inc., and Parthenon Group in manufacturing, operations, process improvement, product design, marketing and strategy.

Currently, Sharad is working towards completing his MBA at the MIT Sloan School of Management in Cambridge, Massachusetts. He also holds a masters degree in mechanical engineering from the Georgia Institute of Technology where he was a Woodruff Fellow and conducted research on environmentally conscious design and manufacturing in small and medium enterprises. Prior to that, he completed his bachelor's degree in mechanical engineering at the University of Maine where he was inducted into seven honor societies, a recipient of eight scholarships and two International Student of the Year awards.