

# 11

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## System Conception

**11.1** Here is elaboration for an antilock braking system for an automobile.

- a.** An antilock braking system could target the mass market. If the antilock system was inexpensive and safer than current technology, it could be government mandated and installed on all cars. (Further study would be needed to determine what price is “inexpensive” and what would be a “significant” safety improvement.)

There would be several stakeholders. Auto customers would expect improved safety and minimal detriment to drivability. Auto manufacturers would want to minimize the cost and quantify the benefit so they could tout the technology in their advertising. The government would be looking for a statistical safety improvement without compromising fuel efficiency.

If the new system was inexpensive, worked well, and did not hurt drivability, all car owners could be potential customers. An expensive antilock system could be a premium option on high-end cars.

- b.** Desirable features would include: effective prevention of brake locking, ability to detect excessive brake wear, and acquisition of data to facilitate auto maintenance. Some undesirable features would be: reduced fuel efficiency, reduced drivability, and greater maintenance complexity.
- c.** An antilock system must work with the brakes, steering, and automotive electronics.
- d.** There would be a risk that an antilock braking system could fail leading to an accident and a lawsuit. Also it might be difficult to understand fully how the antilock system would interact with the brakes.

**11.2** Here is elaboration for Internet bookselling software.

- a.** An Internet bookseller would most likely seek a large market. There is a modest profit per book and quantity would be needed to realize significant revenue.

Both individuals and businesses would be potential customers. Individuals would tend to buy in small quantities, while businesses would occasionally order large quantities. Another important stakeholder would be bookselling companies; use of the Internet would let them reduce personnel costs and centralize inventory, reducing inventory costs.

Once again the potential market would be large. Computer owners with Internet access would be candidate customers. Even the general public could be target customers, since the Internet can be accessed from many libraries, Internet cafes, and sometimes within conventional book stores.

- b.** Desirable features would include: a simple user interface, a fast response, and a vast offering of books. Modern-day Internet booksellers go even further by building an online virtual community through which customers can exchange comments and opinions about books. Some undesirable features would be lack of security for credit information, insensitivity to user privacy, and a buggy/unavailable Web site.
- c.** An Internet bookseller must work with credit card processing systems, order fulfillment systems, and financial accounting software.
- d.** One risk would be illegal hacking of customer information. Another risk would be excessive competition and an inadequate profit margin to cover overhead and operating costs.

### 11.3 Here is elaboration for kitchen-design software.

- a.** Basic software could be targeted at do-it-yourself homeowners. Advanced software could target kitchen remodeling firms.

The potential customers would be stakeholders. The sponsoring firm would have a financial stake in the cost of development and the subsequent revenue. Kitchen suppliers could benefit if convenient software created additional demand for their merchandise and services; as a consequence they also might be willing to fund development.

There is only a modest number of kitchen remodeling firms so there would be a limited market for the advanced software. However, if the software delivered substantial benefit they might pay a premium price. Similarly, our guess is that only a small fraction of homeowners would consider using the software themselves. Consequently, kitchen-design software would only be profitable if it could be developed at a low cost—maybe by adding to general-purpose drawing software—or the software development firm derived revenue from remodeling projects.

- b.** Desirable features would include: 3-D graphics, ease of use, and an ability to estimate project cost, both for do-it-yourself and subcontracting. Undesirable features would be: buggy software, a slow user response, and a lack of rich kitchen features.
- c.** Kitchen-design software must run within an operating system, such as on PCs or Apple Macs. The design software might be based on general-purpose graphics software, in which case, it would have to operate satisfactorily with that. It would be helpful if the design software could export bills-of-material to other systems that might manage raw materials (especially for kitchen remodeling firms).

- d. One risk would be that the software would be too difficult for the typical person to use—this would limit sales. Another risk would be that the software would have insufficient features and not be of significant help.

**11.4** Here is elaboration for an online auction system.

- a. The application would be targeted at the mass market.  
Stakeholders would be the customers, the sellers of goods, and the company owning the online auction software.  
Most everyone with a PC and Internet access could be a customer, as well as persons who visit libraries and Internet cafes.
- b. Auction software should make it easy to find desired goods, it should have the trust of both buyers and sellers, it must run fast, be highly available, and have low cost. Undesirable features would be: an awkward user interface, a lack of sufficient inventory, sale of illegal items, and slow shipment.
- c. Systems with which an online auction system must work are: credit card processing, Web browsers, and help software.
- d. One risk is that online auctions could involve illegal products; countries have various rules that must be enforced. Another risk is that the buyer or seller might cheat—buyers may not honor successful bids and sellers may not deliver merchandise which has been paid for.

**11.5** [Student answers may vary widely from the answers given below.]

- a. **bridge player.** Develop a computerized bridge playing system. The system will support as many as four players. From zero to four of the players will be computer generated. The computer must deal random hands, bid using standard conventions, play any hand, and keep score. All computer generated opponents must be “honest” and not take advantage of any knowledge of the hidden cards of opponents. There should be a setting for level of difficulty which the human user can adjust. The program must have an excellent, user-friendly interface with high resolution color graphics and quickly determine bids and plays. It is permissible for performance to degrade as the level of play becomes more difficult. The system should keep an optional log in which it records the cards dealt and the bids and plays for a given game. The system should also accept a predefined deal and bid and play list; this is useful for studying fine details of a bridge game.
- b. **change-making machine.** Design the software for a machine that accepts paper currency and returns change. Important design goals in order of importance are: rejection of counterfeit and foreign currency, determination of denomination, correct dispensing of change, software versatility, and low cost. The software may be custom written for a particular microprocessor chip. Versatility refers to the fact that the software must be configurable to a variety of conditions. The software must be easy to reconfigure for international use with different types of currency and different formulas for dispensing change. The software must allow a fee to be imposed for change-making service.

- c. car cruise control.** Design a cruise control system for an automobile. The control has four buttons: *on/off*, *set*, *coast*, and *resume*. Once the control system is on, the driver accelerates to a desired speed and presses *set*. The speed will be maintained within a fixed tolerance until the driver hits the brake or presses the *off* button. The driver may accelerate above the preset speed by using the accelerator; once the accelerator is released the car will resume the preset speed. If the driver hits the brake, the cruise control is disabled until the driver presses the *resume* button at which time the car will resume the preset speed. If the driver holds the *coast* button, the car will decelerate until the button is released at which point the car's speed becomes the new desired speed. Abrupt changes or oscillations in speed will be avoided.
- d. electronic typewriter.** Design the software and hardware for an electronic typewriter. The typewriter only has to support the standard *QWERTY* arrangement. Keys that are not letters and numbers can be arranged in the manner that seems most appropriate. Cost of the typewriter is paramount; intentions are to aim for the low end of the marketplace. The power supply need only handle the standard 120 volts of North America. Color of the typewriter is irrelevant—choose an inoffensive color that is inexpensive. The typewriter should be lightweight and easy to assemble; it need not be easy to repair. The typewriter should have a one-line electronic display; the line does not print until the carriage return is pressed. This buffering simplifies correction of minor typing errors.
- e. spelling checker.** Design the software for a spelling checker. The spelling checker must find incorrect words in a document and suggest corrections for all misspelled words. The spelling checker must use a word dictionary and permit the user to add new words. The software must run on PCs and integrate with a variety of word processors. It must be memory resident and easily activated with a few keystrokes. The spelling checker must accept commands from both a mouse and keyboard; keyboard commands should be redefinable by modifying a configuration file. The software must be easy to use and present a polished pull-down menu interface. It is important that the system occupy as little memory as possible.
- f. telephone answering machine.** Design the software for a telephone answering machine. The software must provide the following services as a minimum: answer the phone after a predetermined number of rings, play a recorded message, record the caller's message, and hang up after a predefined length of recording. The software should support remote dial-in and identification by password to hear any recorded calls. The software should be suitable for burning into ROM. As such it is important that the software be small in size and extremely reliable since it would be very costly to update the equipment once it is in a customer's hands. The software must operate in real-time but early projections are that this goal is easy to meet with modern microprocessors. You may choose any CPU chip for developing the software that you choose, but the wholesale quantity price of the CPU chip must be \$10 or less.
- 11.6a.** A system to transfer data from one computer to another over a telecommunication line. The system should transmit data reliably over noisy channels with a failure rate of less

than 1 in  $10^9$ . Data must not be lost if the receiving end cannot keep up or if the line drops out. The system must keep pace with the fastest dial-up rate (currently about 60K baud). The system should support several common error correcting protocols.

- b.** A system for automating the production of complex machined parts. The parts will be designed using a three-dimensional drafting editor that is part of the system. The system will produce tapes that can be used by numerical control (N/C) machines to actually produce the parts. The system must be developed in x months and cost no more than y dollars. The system will support the following machining operations...
- c.** A desktop publishing system, based on a what-you-see-is-what-you-get philosophy. The system will support text and graphics. Graphics include lines, squares, rectangles, polygons, circles, and ellipses. The system should support interactive, graphical editing of documents. The system must run on the following hardware configurations... It must be capable of printout in *Postscript* and *PDF* formats. The software must support the following operations... and be extensible and maintainable.
- d.** Software for generating nonsense. The input is a sample document. The output is random text that mimics the input text by imitating the frequencies of combinations of letters of the input. The user specifies the order of the imitation and the length of the desired output. For order N, every output sequence of N characters is found in the input and at approximately the same frequency. As the order increases, the style of the output more closely matches the input. Working memory must be constant and not proportional to the size of input or output text, but the entire input document is randomly accessible at run time. Time performance should be proportional to N and to the number of output characters.
- e.** A system for distributing electronic mail over a network. Each user of the system should be able to send mail from any computer account and receive mail on one designated account. There should be provisions for answering or forwarding mail, as well as saving messages in files or printing them. Also, users should be able to send messages to several other users at once through distribution lists. Messages must not be lost even if the target computer is down.