Veterinary Prosthetics

Consider a canine front double amputee (i.e., hind legs intact, but fore legs gone – humerus removed from the scapula). The owners of the dog would like it to achieve mobility and independence.

1. Develop a list of users; underlying needs; and functional customer requirements for a prosthetic device to satisfy the basic need.

Users:
- Certainly the dog itself (end user).
- The dog owner, in the sense of an end user (installer and maintainer of the device), and as a device owner (purchaser, carries financial responsibility for successful function).
- And something up the supply chain, like Manufacturer or Veterinarian (acting as marketer/distributor).

Underlying Needs:
- Dog
  - Mobility in and out of doors, to play, to investigate people/dogs/things, to feed/water, to poop/pee
- Owner
  - Dog to be healthy (no bruises), at least semi-independent, functionally house-broken
  - Cost within ability and desire to rehabilitate a favored pet. Cost not in excess of what a pet owner will pay for rehabilitation of a favored pet.
- Supply
  - Easy to fit device, and train owner and dog in its use

[Note that there is no underlying need to fit a variety of dog sizes. That would be a design outcome, not a need. The associated need is to fit the dog. This could be met, in design outcome, by either: a variety of sizes; adjustability; or custom manufacture. Note also that acceptable cost depends on willingness to pay, and willingness to pay depends, to some extent, on the level at which other needs are met. For instance, an owner might be willing to pay much more for neurally-controlled robotic legs than for a strap-on dolly – this doesn’t mean that the owner would be willing to pay that same robotic price for even the very nicest dolly. Identification of cost need takes a lot of reflection and flexibility – try to identify the value source of willingness to pay.]
Customer Requirements:

- **Attachment to dog**
  - Stability of attachment (i.e., stays in one place on dog)
  - Little time spent fussing with device
  - Device does not pinch or abrade dog

- **Dog mobility**
  - Dog can move forward
  - Dog can move backwards
  - Dog can surmount indoor obstacles
  - Device does not damage indoor flooring and drywall any more than the installation of granite countertops already has
  - Dog can cross outdoor terrain
  - Dog can corner
  - Dog is self-righting in capsize or pitch-pole

- **Dog self-care**
  - Dog can self-feed and water (may need a companion device here – for instance, the prosthetic may only allow the dog to have a range of pitch motion at the muzzle associated with neck movement – no crouch. So with the non-crouching prosthesis, there would be a need for elevated food and water bowls. A need for the elevated bowl may be that it will allow the dog to tuck up next to it. Or a need for the prosthesis may be that it tucks back out of the way of the bowl. This brings up an advanced topic – “System Requirements”)
    - Mobility of dog’s hindquarters is not impaired

- **Cost**
  - Dog’s recovery of quality of life seems commensurate with cost of device. (Note that the owner has already paid for some pretty extensive veterinary surgery – this may be a measure of the strength of the emotional bond).
  - Minimal return visits to the Vet should be required on account of the device.
  - Device should survive the dog.

Note that each CR can be tied back to a user and an underlying need, and that each underlying need is specifically addressed by one or more CR’s. Note also that the CR’s are a complete summary of the design problem – the users and needs can be dispensed with (though we will not do so – we will go back later and make sure that future steps in the design process satisfy the original users and needs, as well as the preceding sequential design process step).

Also also, note that this is just one of the infinitely many possibilities of users/needs/CR’s. Some of these possibilities are good, and lead to a lean and successful design process – others are bad - or shall we say, ‘less useful’.