KaR Contract C1 – P08

Report

An Evaluation of the DTW Mk5 Low Cost Brailler (PrinSon Brailler)

June 1st 2003

Contents

1. Background and description of the evaluation in May 2003 in Cambodia

The DTW Mk5 Braille Writer is the result an ongoing design and development process spanning over two years. Earlier developments resulted in design changes and a final prototype Braille writer which is lighter and smaller than the previous DTW prototypes, with improved functions.

Initial evaluation of the Mk5 was carried out in Cambodia in cooperation with staff and students from the Cambodian Association for the Blind (ABC) and Krousar Thmei (KT), the main NGOs working with the visually impaired.

The tests were conducted at the Krousar Thmey school for the blind near Phnom Penh and was also attended by Ms Kawabata from the Kusanone Fund of the Japanese Embassy who is interested in the continuation of the development of the Brailler to bring it to commercial production.

Krousar Thmey currently has more than 150 blind students enrolled in 4 schools in Cambodia. They have 33 Perkins Braille writers but have difficulties in keeping them operational. KT does not routinely teach students to use mechanical Braille writers due to the low numbers of high cost machines but will consider more widespread use if cheaper typewriters can be acquired and maintained.

The machine was tested against a list of specific criteria, based on the previous evaluation and the users were encouraged to give feedback. While some users knew how to operate a Perkins Braille writer (the most commonly used) and wanted to compare the two machines, the purpose of the test was not a direct comparison, as they are very different in design, manufacture and cost.

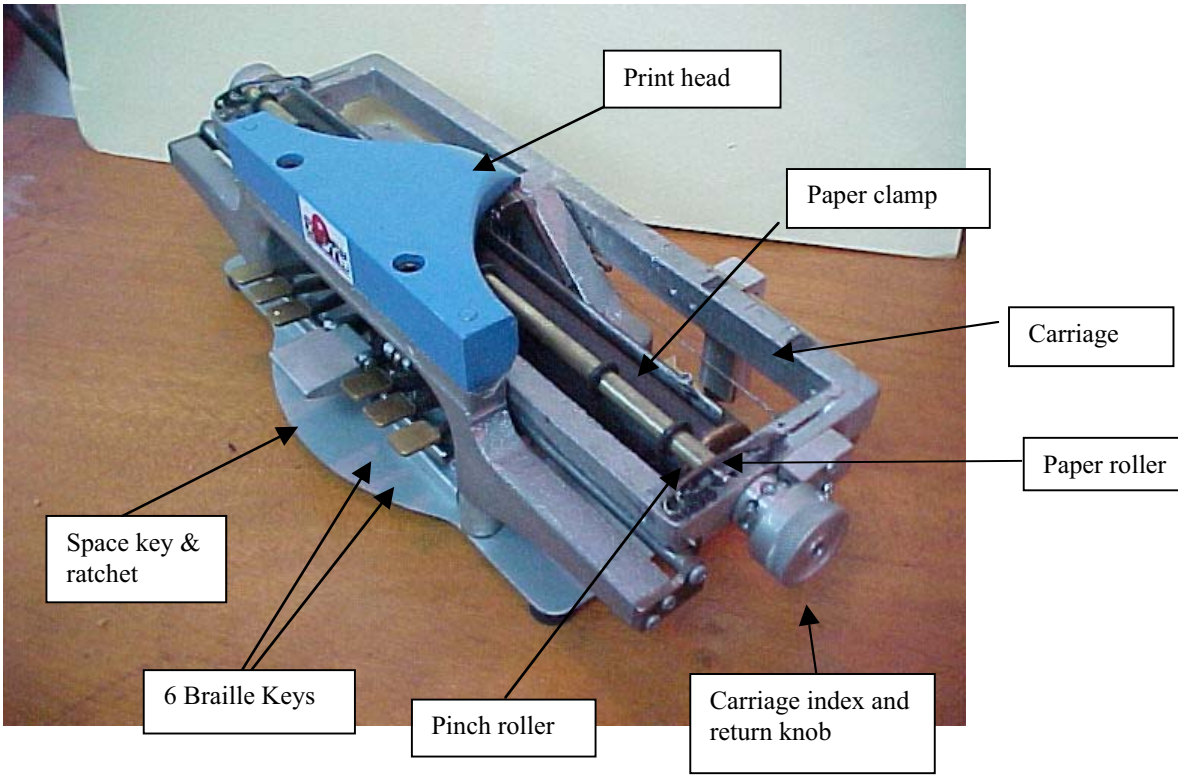
Rather, the main objectives of the evaluation were to check that the quality/cost ratio of the Mark 5 Brailler was satisfactory to pursue its development into local production.

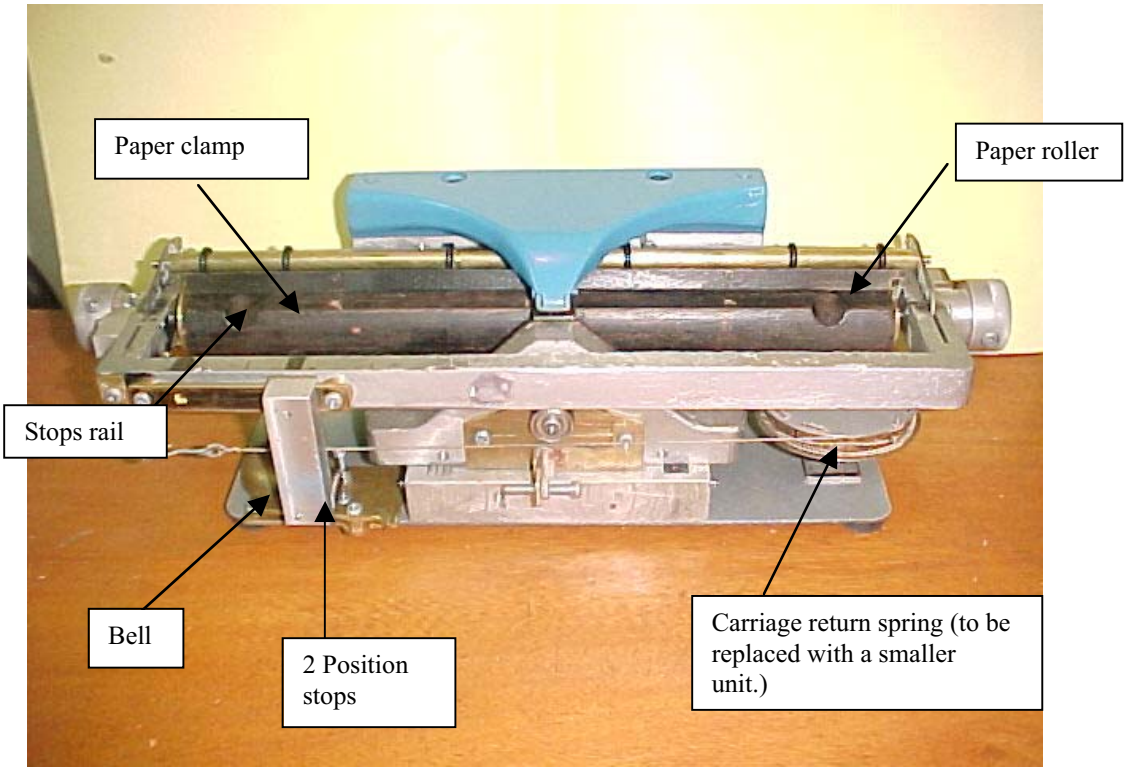
The main criteria are as follows:

1) To check the general ergonomics and user friendliness of the machine
2) To ensure that the quality of the Braille produced is satisfactory
3) To ensure that the machine is suitable for use in a classroom and by children
4) To ensure that the general quality of the prototype is sufficient to go to the next stage of development which will be to develop tooling to manufacture the Mk5 on a mass production basis without having to produce another prototype
5) Technical details such as: position, size and operating pressure of the keys; carriage, roller and paper handling and dot and line spacing.

We did not test the machine for reliability or aesthetics as these are functions which can only be properly ascertained with a pre-production model manufactured using the tools and methods which will be used to mass produce the PrinSon Braillers.

2. DTW Mk5 Prototype PrinSon Braille Writer





How the Mk 5 Operates

Braille Pins and Keys

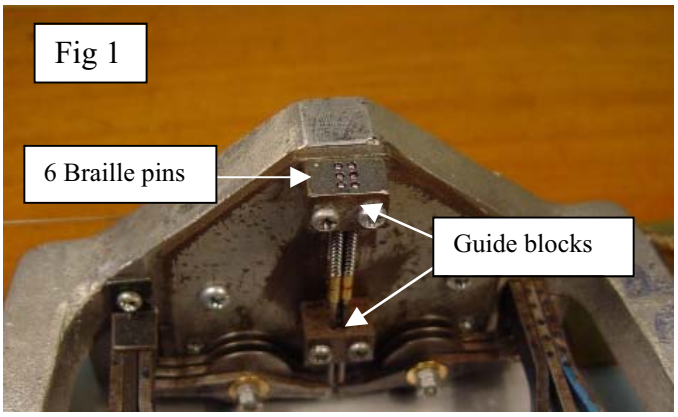


Fig.1

The Mk5 operates through a system of 6 Braille keys that actuate pins that rise vertically through a guide block.

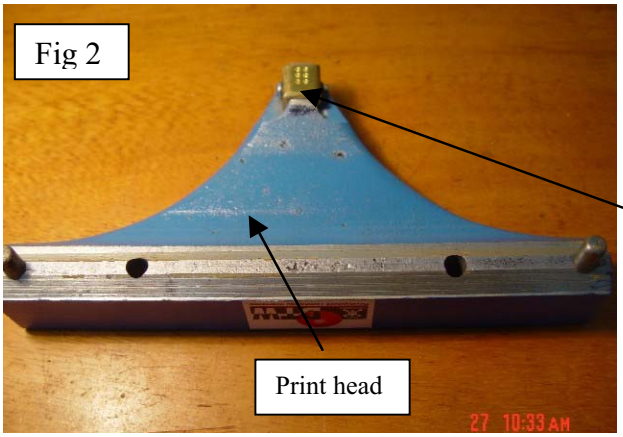


Fig. 2

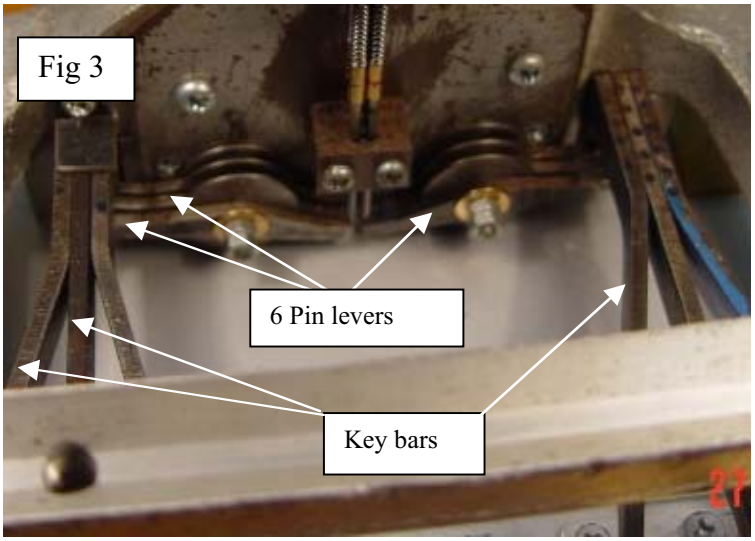
The pit plate is made from brass and is fixed to the print head with on 3mm screw. Adjustment is not possible, the pit plate alignment being set during manufacture. The pins rise into a brass pit plate.

Fig.3

The six Braille pins are actuated through six small leavers that connect to the keys.

The lengths of these levers is critical in order to obtain a constant force from each key.

The key bars are also visible



Keys and Ratchet /Rack, Space Key

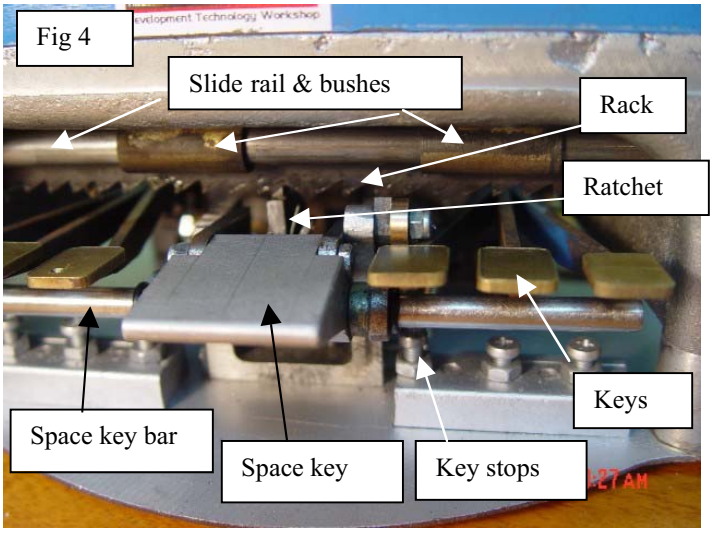


Fig. 4

The space key operates the ratchet that indexes the carriage to create a space between each cell. When operated, the individual Braille keys actuate the space key bar, and at the same time the ratchet. Key travel is controlled through adjustable individual key stops.

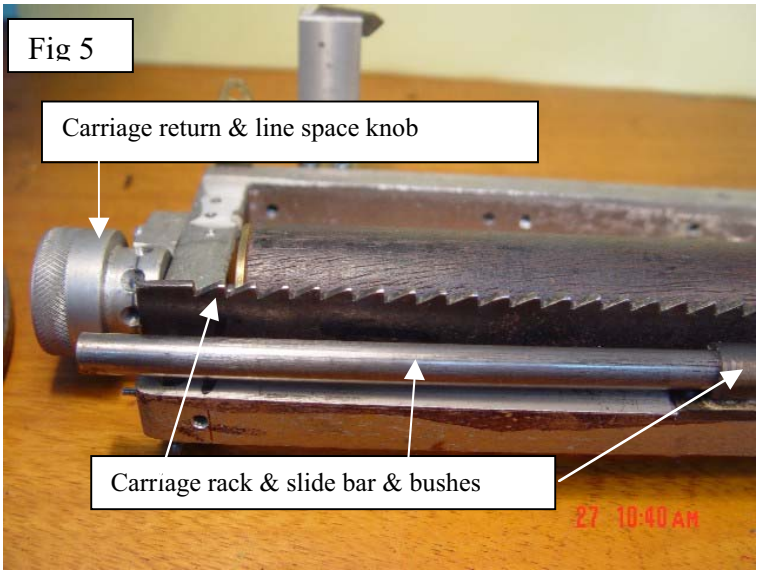
The rear carriage slide rail and bushes are also visible.

Carriage Details

Fig 5

The picture shows the carriage inverted. The rack, slide bar and bushes are shown.

At the left of the picture is the carriage return knob which also controls the line spacing



Moveable Stops and Bell

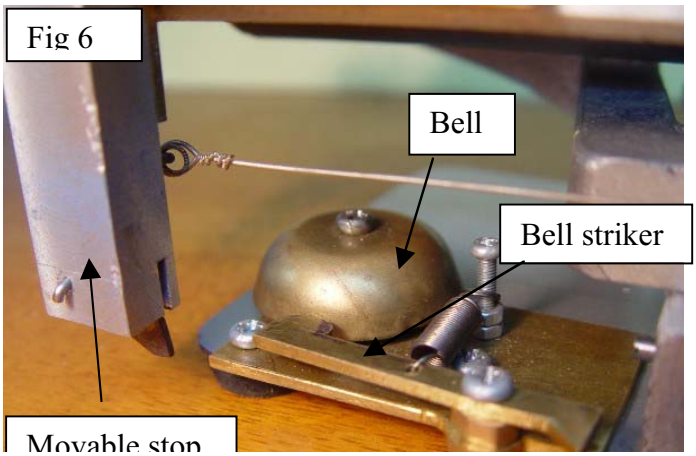


Fig 6

At present there are two stop positions, 1 for A4 size paper and one for 255 x 340 Manila heavyweight paper. More stop positions will be provided on the production model.

The bell sounds 6 spaces before the end of the line is reached.

Carriage, Roller and Return Spring

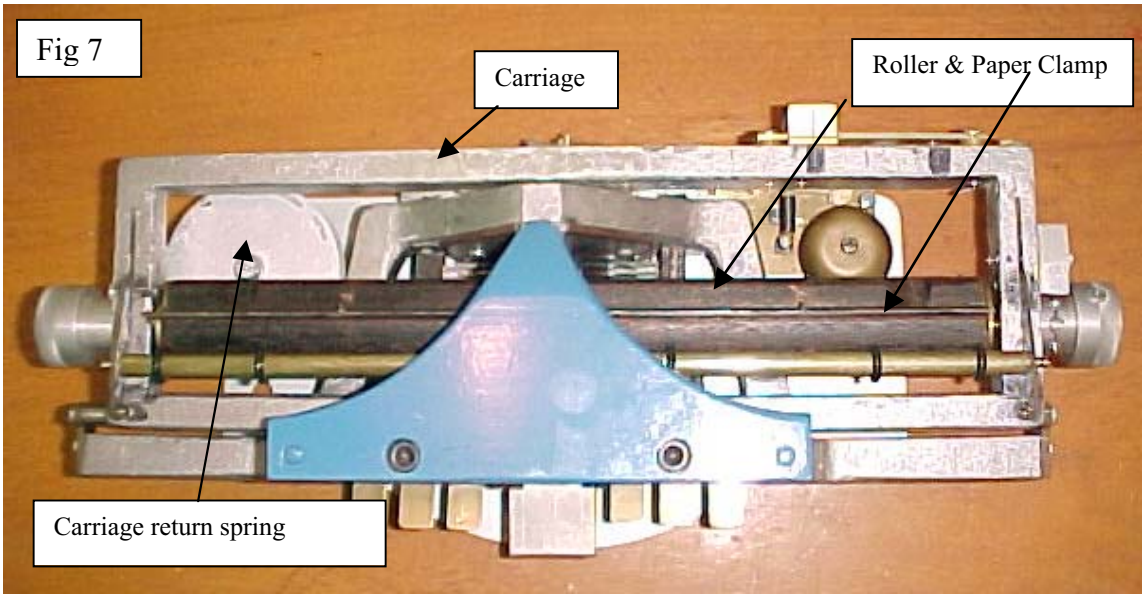


Fig 7.

The paper roller and clamp will be replaced on the production model in favour of a more functional and user friendly unit. The return spring shown was taken from an old mechanical typewriter and will be replaced by a smaller, lighter unit.

3. Technical profile of the DTW Mk5 Braille Writer

Design: Mr Michael Prince, B.Eng. from Warwick University. Chief design engineer and General Manager of DTW since 1996.
Prototyping: Mr Harold Pearson, 30 years of experience in technology development and transfer in developing countries and Country Programme Manager since 1998.

	PrinSon	Perkins
Weight (kg)	3.5	4.7
Length over carriage (mm)	370	370
Width over base (mm)	135	230
Height (mm)	105	150
Braille and space key operational travel (mm)	17	20
Force required to fully depress Braille keys (g)	300	300
Force required to operate space key (g)	400	400
Total key force to create Braille (g)	700	700
Force to return carriage (g)	1,000	1,000+
Desk space needed for operation (mm)	590	370
	movable carriage	fixed carriage
	fixed head	movable head

The Mk5 is a basic machine that is designed to be manufactured and serviced at low cost in developing countries. The prototype under evaluation has only two stops for two sizes of paper – A4 and a 255mm by 340mm manila heavyweight (about 120gsm).

The carriage is pushed to its return position by hand and the paper indexed to the next line by rotating a knob on the end of the carriage through one index point. A standard typewriter constant force return spring is used to return the carriage.

Paper is loaded onto the roller by lifting the spring loaded clamp that runs the full length of the roller. With the paper in place that clamp is closed. The paper is then wound onto the roller using the knurled knobs at each end of the carriage.

A moveable stop with two positions is fitted to the rear of the carriage that matches the two sizes of paper used. A bell rings when 5 spaces remain to the end of the line and there is a 25mm right hand margin.

The left hand paper alignment will be guided by a tactile paper gauge and the margin will be decreased to about 20 mm by notching the main frame to allow the carriage to travel further. This will also increase the number of available strokes per line by 2 or 3.

The top margin is adjusted by feel between the edge of the paper and a tactile indicator of the type line on the LHS of the carriage will be added so as to avoid putting fingers near the print head.

One possibility would be to produce the PrinSon Brailler with 2 different sizes and spacing of the keys, so as to be more comfortable for children and adults.

4. Testing and evaluation

Summary of the evaluation against set criteria

1) *To ensure that the users can use the machine satisfactorily and comfortably after minimal training*

All users mastered using the machine after a few minutes of instruction. The operations which offered some difficulties were the accurate loading of the paper; the requirement to use the full travel of the keys to make clear dots; an awareness of when the carriage had reached the end of its travel in order to avoid over typing; an awareness of when the bottom of the page had been reached. Adults found the keys a little small and too close together. Solutions to these issues are discussed below.

2) *To ensure that the quality of the Braille produced is satisfactory*

The Mk5 produced satisfactory quality Braille dots at all speeds and on all the types of paper already in use. This was checked by having another person reading satisfactorily what the typist had written.

3) *To ensure that the machine is suitable for use in a classroom and by children*

The machine is still a bit too noisy for classroom use but it was determined that the ratchet noise was acceptable and that the keystroke noise can be easily and cheaply reduced. Its size, weight and safety were deemed satisfactory and only needs the addition of a simple protective cover.

4) *To ensure that the quality of the prototype is sufficient to go to the next stage of development which will be to develop tooling to manufacture the Mk5 on a mass production basis*

The overall quality of the machine is satisfactory and the improvements to be made are small enough to be implemented either on the current prototype or easily incorporated into the (pre-) production models.

5) *Technical details such as: position, size and operating pressure of the keys; carriage, roller and paper handling and dot and line spacing.*

The operating pressure of the keys posed no problem and the users rapidly learned to use the full travel of the keys. Dot and line spacing was satisfactory and all operations relating to paper handling will be redesigned for greater user-friendliness.

Details:

Five KT students, including one young woman, took part in the evaluation. They were selected based on their previous experience with mechanical Braille writers and their physical size (children and adults).

A senior KT technician (sighted) assisted with basic orientation of the students to the systems and workings of the Mk5. The DTW machine differs from the popular Perkins machine used at KT. In contrast to the DTW Brailler, the Perkins has a print head that moves along and does not have a sliding carriage.

Students were not familiar with the paper loading and clamping system and with the bell warning the approaching end of the line being typed but adapted well once shown, though a few tactile improvements will be made.

Several grades of paper were used with the following results:

a) Double thickness of standard A4 80gsm: good dot quality.
b) A4 120gsm paper: good dot quality.
c) Thick computer print-out paper (unknown weight): good dot quality.
d) Acetate: good dot quality. This medium can be used for producing long lasting documents or for making masters through an embossing process. This latter process has not been investigated.

Issues which came up during the test

a) At first the quality of the dots was not deemed sharp enough.
When typists were taught to use the full travel of the keys, the sharpness increased to satisfactory levels. This sharpness of the dots is not dependent of key speed or pressure but on using the full travel of the keys.

b) Some of the dots were not perfectly lined up with each other.
The paper does not lay flat as it goes under the print head and slightly distorts the dot pattern. This will be remedied with by placing the pinch roller directly on top of the main roller, thereby keeping the paper flat.

c) Typists would keep typing after the carriage had hit its stop though they had heard the bell giving them a 5 space warning.

It is usual to use an auditory signal to indicate the end of the line and training and practice usually eliminates this problem. A mechanical solution to prevent over typing at the end of the line would be too complicated to include in this machine.

d) Typists had some difficulty with the positioning the paper with reference to margins

The whole aspect of feeding the paper accurately and making the margins automatically will be re-designed into the current prototype and will include more paper guides and tactile markers.

Specific technical issues

Although several deficiencies were noted, none of them warrant the construction of another prototype and all can be addressed with the current prototype and sub-sequent pre-production models.

The technical issues fall into two categories, those requiring significant changes (items 1 to 5) and the others which are simpler to implement:

1) The pinch roller needs to be repositioned over the vertical centre line of the roller so as to keep the paper flat under the print head
2) A positive indication for a bottom margin, when the bottom edge of the paper has been reached

Prior to the evaluation it had already been decided to change the design of the of the pinch

guide on LHS) and incorporate a bottom page margin stop. The stop would effectively inform the user when they had reached the bottom of the page by preventing the roller from moving until the paper has been removed.

3) More margin stops
This problem will be addressed by increasing the length of the stops rail and the inclusion of a measured number of stop points.

4) If possible sharpen Braille dots, though this is not essential
This modification can be carried out with a slight change to the profile of the Braille pins.

5) Suitable mechanism for single back space
An 8th key on LHS or RHS with either vertical or horizontal movement will be added.

6) A paper alignment guide to be fitted at the left hand side
A simple right angle guide will be added to the carriage frame.

7) Carriage should return further to give 3 or 4 more characters per line
An indentation on side of the main frame will be made to the main frame to allow the carriage to move further to the right.

8) Key pads are too small and too closely spaced for adults and require a small indent for finger placement
The keys will be slightly angled laterally and made longer with a finger positioning indentation or slight lip at end.

9) Larger and more tactile carriage return and roller index knobs

These two knobs (one at each end of the roller) will be made slightly larger, knurled and with a tactile indexing reference.

10) reduce key stroke noise
The key stops will be coated with a plastic material to remove the metal-to-metal noise.

11) lockable carriage for transport
A simple latch will be added to lock the carriage in a central position when moving the machine.

12) key lock when end of travel carriage to avoid over-typing when the carriage has reached its end of travel

This feature is not commonly used on other machines and will not be investigated as the bell gives the user an indication that only 5 typing spaces are left and would add too much complexity.

13) Ease of lifting and carrying
Two finger grips will be added on top of the anvil/print head to allow for more secure grasping of the machine and 2 larger finger holds will be fitted to the protecting case.

14) Exposed machinery
A simple protective casing made of sheet metal at first (and possibly of moulded plastic later) will be added and will protect the most fragile parts, including the carriage return spring wire. The first option is to make a small casing outside of the carriage movement but leaves the stop bar and screw somewhat exposed. The second option is to make a larger

5. Summary list of findings

This is the list of issues from the Mk 3 prototype as applied to the Mk 5:

Issue		Y/N NA	Comments
1. Braille Quality			
5.1.1	The MK5 can produce good quality Braille	Y	Consistently
5.1.2	Dot and cell size is the large 'jumbo' size, as used by learners	Y	
5.1.3	The spacing between lines is too great	N	OK
5.1.4	The margin at the bottom is difficult to judge	Y	to be improved
5.1.5	The dot quality with heavy Braille paper is not as good	N	OK
5.1.6	The horizontal spacing of the dots in a cell could be too great	N	OK
5.1.7	The spacing between cells can be too small	N	OK
5.1.8	'Ghost' dots can sometimes occur	N	OK
5.1.9	All the problems with Braille quality occur when the operator tries to type quickly – at low speeds, quality is consistently good	N	OK
2. Ergonomics			
5.2.1	The force required to operate the Brailler was too high	N	but needs full travel
5.2.2	The noise from the machine was too great	Y	to be improved
5.2.3	The machine is quite heavy	N	OK
5.2.4	The gap under the base-plate could be reduced.	NA	different design
3. Functionality			
5.3.1	The pinch roller slips causing erratic new line spacing	NA	different design
5.3.2	The paper can easily twist as it is rolled on, a guide would help	NA	different design
5.3.3	Back-spacing is not accurate enough to allow reliable correction of mistakes	N	can be accomplished by using 2 hands
5.3.4	Its too 'naked' – needs more covers, or kids will play around with (and break) the mechanisms	Y	to be improved
5.3.5	Angle of the keys is too high	N	
5.3.6	Carriage is too wobbly, contributing to the misalignment when backspacing, and also to the ratchet problems	N	
5.3.7	Too many loose parts	N	
5.3.8	The carriage advance knobs need to be knurled to give better grip	Y	to be improved
5.3.9	Put the spikes on the paper grabber plate, not on the wooden roller, this makes it less likely the paper will slip	NA	different design
4. Additional Features Requested			
5.4.1	A limiter to stop the paper being wound too far onto the roller	NA	
5.4.2	A line advance lever would be better than the roller knob with détente springs system currently used	N	too complicated to add
5.4.3	Carrying by the hammer is not good – better to have a proper carrying handle incorporated (this could also form part of a cover which folds over the hammer to protect it during transport?)		to be improved
5.4.4	Would be good if the keys could not be pressed once the carriage has reached the end, so the person doesn't keep typing away in the same place: The bell should warn them they're near the end, but they may not hear it!	N	no easy solution and not done on others.
5.4.5	A little rubber on the ratchet spring would really reduce the noise level	NA	
5.4.6	Backspace key	N	will be added
5.4.7	Handle to push the carriage back when a line is completed	N	too complicated and not necessary

6. Conclusions

1. A brief market survey has indicated that there would be a demand for several hundred units annually.
2. The Mk5 has proven that the basic dot creation system used is a simple and easily manufactured which produces high quality Braille on a variety of media.
3. The Mk5 has proven the concept of low-cost local production of a mechanical Braille-writer
4. Only minor improvements remain do be implemented to make the machine completely satisfactory.

7. Suggestions for continuation of the project

The next phases of the project are as follow:

1) Make improvements as suggested by this evaluation (1 month)
2) Run a final local evaluation to insure that all issues have been addressed
3) Manufacture all the production tools (6 months)
4) Produce and thoroughly test 15 pre-production models
5) Make final adjustments to the production system
6) Acquire, set-up and equip a production workshop in Cambodia (3 months)
7) Recruit and train technicians and administrative staff (6 months)
8) Start producing and selling the PrinSon Braillers

This report was written by Mr. Harold Pearson and Mr. Bernard Crenn.

We thank the participants from ABC and KT who have kindly participated in this evaluation.
It was read and approved by Mr Bun Mao, Director of ABC and Mrs Phalla, Director of School for the blind of KT.

Date:

Appendix A – Details of organisations involved in the evaluation in Cambodia

1. Association for the Blind in Cambodia (ABC)

BOUN Mao (director)
#3 Street 254
Corner of Street 55
P.O.Box: 175
Phnom Penh

Tel: 012 914983
Email: ABC@bigpond.com.kh

2. Krousar Thmey

Mrs NIENG Phalla
School Director for the Blind
Coordinator of Education for the Blind and Deaf
Chbar Amprov il
Khan Mean Chey

Tel: 855-23 360 681 / 012 949 099
Email: krousar-thmey@bigfoot.com

Appendix B - Some photos of the evaluation at the Krousar Thmey School for the Blind in Phnom Penh on May 22nd 2003.

Young student Niam Sinath age 14, learning to use the PrinSon Brailler.

2 Perkins braille writers can be seen in the background.

The machine will be fitted with a casing for protection, ease of transport and aesthetics.

This young man, Aeng Pheaket age 15, had never used a braille writer before and learned to use it well very fast.

He enjoyed it so much that we had some difficulty getting him to stop using the machine!

View of the PrinSon Brailler in action. Note that it is easier to use 2 hands to move the carriage and index the paper to the next line, though it can be done with one hand.

Currently the backspacing is done in the same manner and using 2 hands is faster and more accurate.

An additional key will be fitted to allow easy and accurate one-finger