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TACOM/ARDEC PERSONALIZED WEAPONS TECHNOLOGY PROGRAM MEETING REPORT

Lucian Sadowski
Stephen C. Small, Ph.D

November 2001

US ARMY
TANK AUTOMOTIVE AND
ARMAMENTS COMMAND
ARMAMENT RDE CENTER

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

Close Combat Armaments Center

Picatinny Arsenal, New Jersey

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14. ABSTRACT

On 26 Oct 2000, the Joint Service Small Arms Program at the U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey hosted a meeting between representatives from the New Jersey Institute of Technology (NJIT) and personnel from the Close Combat Armaments Center. The meeting was the first of a planned series following the July 2000 signing of a Memorandum of Agreement between ARDEC and NJIT for support in the development and selection of technologies applicable for "smart gun" or "user only" gun technologies. NJIT was tasked by the State of New Jersey to research the state-of-the-art and near future technologies and systems with the goal of determining if they could reduce the number of accidental and purposeful shootings (to include suicide) by unapproved users of the weapon. The State of New Jersey has mandated that handguns be equipped with user identification or authorization technologies, when such technologies are available and developed to a suitable extent. These technologies also have potential application for use with future sophisticated small arms. Such weapons if captured by enemy combatants could pose a significant threat to friendly forces. Technologies to disable the weapon and prevent unauthorized use are of interest to the U.S. armed forces.

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Mr. Phillip Baker
Mr. Larry Ostuni
Dr. Jeff Widder*
Mr. Frank Dindl
Mr. Piotr Frey
Mr. David Skeldon
Mr. Sergio Aponte
Mr. Clark Fishman
Mr. Bud Romaine

*Author of meeting minutes and contributor to meeting findings.

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Dr. Don Sebastian
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Mr. Joe Giampiapa
Mr. John Lacontory

CONTENTS

EXECUTIVE SUMMARY

In accordance with the provisions of the New Jersey Institute of Technology (NJIT)/U.S. Army Armament Research, Development and Engineering Center (ARDEC) Memorandum of Understanding (app A), the Joint Services Small Arms Program (JSSAP)/Close Combat Armaments Center (CCAC) Personalized Weapons Technology Program meeting was held 26 October 2000 at Picatinny Arsenal, New Jersey (app B). The purpose of the meeting was to assess several commercially off-the-shelf and emerging technologies that might lead to the development of personalized small arms for Law Enforcement and/or private citizens.

Central to our meeting was the "authorized user(s)-only operational" metric. This metric was grounded upon the presupposition that both Law Enforcement professionals and/or civilians need firearms to be as safe to possess/own as they are to operate. All of which must be reconcilable with the extremis inherent in defending hearth and home. That is, they require a firearm that is both safe and reliable. Additionally, any device that renders the firearm non-operational must be reasonable to the extent that it is does not defeat the end for which the weapon is owned and/or carried: lethal force directed against a present and immediate threat to ones life or the lives that one is charged with protecting. The meanings assigned to the term "reasonable" remain manifold. However, the tradition of safety devices on firearms is longstanding and easily understood by layperson and professional alike. In that tradition, we model our effort. Furthermore, it is likely that Law Enforcement professionals and citizens will have to continue to cope with reasonable safety devices and yet make rapid decisions about the identity of potential targets. Therefore, the truly safe firearm remains the one in the hands of a competent and well-trained user. No matter, while technology may fall short of panacea status, it nevertheless might assist in making firearm usage and ownership a safer proposition. A proposition that is reconcilable with private rights and public responsibilities.

Meeting Scope and Nature

The meeting participants (app C) received orientation briefings (app D) on Personalized Weapons Technology issues, as well as the methodology whereby the items to be presented—during the meeting—were to be evaluated.

A total of 18 items were evaluated:

- 7- Hardware
- 11 - Informational

Methodology

Our panel was briefed on 18 commercial items and/or emerging not-yet-available products. That is, available technologies and/or developmental concepts—all of which were possible candidates for the realization of the program objective. The participants constituted a panel of expert opinion and as such were charged with responsibly of considering the several aspects of the problem. The scoring metrics used in this process involved the employment of two evaluation tools: (1) technology evaluation worksheets; the criterion against which these were measured were (2) metric technology readiness levels (TRLs.)—for examples of both these scoring sheets see appendix E.

Briefings on the aforementioned technologies and concepts were followed by a questions and answers session. Afterwards, the panel conducted a "brainstorming" colloquy. This session was conducted in order to tease out any possible permutations of the concepts presented. That is, how might the concepts be modified or expanded to better realize the program objective. The object of both these sessions was to assess the general accommodation of existing or conceptual items with regards to the following questions:

- Is it authorized user(s)-only operational?
- Is it "here and now" it terms of its maturity?
- Might it efficiently impair the functional architecture of a firearm?
- Does it offer any viable military off-ramps?
    - Identification Friend or Foe (IFF)
    - Anti-Theft/Tracking and/or "Shut-off" Capability

A structured facilitation and decision-making process was used to provide a framework for the panel's discussions and to capture their suggestions and recommendations.

Significant observations and recommendations from the panel include:

The items assessed during this meeting do not (in accordance with the TRLs) adequately respond to the "authorized user only operation" metric. That is, no one item is sufficient for meeting the TRLs reliability description under a range of expected operational environments, such as "child-proof" storage, Law Enforcement carry modes, and private citizen home defense.

STEPHEN C. SMALL, PH.D.
PICATINNY ARSENAL, NJ , NOVEMBER 2000

BACKGROUND

What is ARDEC'S Connection To NJIT?

A key objective of NJIT is to provide University researchers with new knowledge with which to improve processes and products for industry. Through public and private partnerships and economic development efforts, the university helps to grow new business ventures that fuel the economy. Similarly, TACOM-ARDEC strives to renew and sustain its connection to the community in which it resides. Therefore, a commonality of interests and civil responsibility made this cooperative pooling of talent a desirable and worthwhile venture for both the NJIT and JSSAP. That is, as specified in the Memorandum of Understanding (MOU)—signed 12 July 2000 by the TACOM-ARDEC Technical Director and the NJIT Vice President for Technology (app A).

What is JSSAP?

In 1978, the Office of the Under Secretary of Defense directed the establishment of the JSSAP with the Army as the Executive Agent. JSSAP's assigned mission is to harmonize the design, development, test, evaluation and introduction into service of small arms for all the Services. The basic thrust is to provide significant gains in combat effectiveness for the near term, while exploring revolutionary advances for the future. The JSSAP is administered by the Army for all the Services (Army, Navy, Air Force, Marine Corps, Coast Guard and Special Operations Command).

What are Small Arms?

JSSAP defines small arms as manportable, individual and crew-served weapon systems used against protected and unprotected personnel and light/unarmored vehicles. Included among these weapon systems are ballistic and non-ballistic systems and associated munitions, aiming, powering, storage and other ancillary items. Current weapon systems include handheld individual weapons, and ground or platform mounted crew-served weapons. Typical examples include: pistols, rifles, automatic weapons, grenade launchers, fire control, ammunition and fuzing.

Why was JSSAP Established?

The 1970's saw an overall decline in funding, across all the Military Departments, for the Research, Development, Test and Evaluation (RDTE) of small arms. The inevitable result was a sharp decline in the overall small arms production and technology base. To reverse this dangerous trend, the Services agreed to establish a centralized, joint-service group to address such small arms goals as the following:

- Prevent the US arsenal from becoming obsolete
- Establish and maintain an efficient national resource for RDTE
- Achieve positive cost benefits and significant performance gains from RDTE in training; logistics; reliability, availability & maintainability (RAM); and rationalization, standardization and interoperability (RSI) [now also known as Multi-National Force Compatibility (MNFC)]
- Provide a focal point for small arms RDTE
- Maintain the technology base for future advances

What are JSSAP'S Basic Objectives?

Basic program objectives are:

- Harmonize joint service needs and efforts
- Execute joint RDTE projects that respond to user needs
- Promote investigation and application of new technology
- Revitalize and maintain US capabilities for RDTE
- Provide a focal point for national and alliance needs/developments

MEETING FINDINGS

None of the 18 items addressed all of the requirements set forth by NJIT for the personalized weapon. The two items answering the majority of factors are:

1. Pistol or gun safes
2. Electronic weapon/electronic ammunition

The one item that stands out that can be used to retrofit a weapon and meet most of the NJIT requirements, is the Saf T Lock Revolver Kit Combination Lock.

Moreover, a significant problem exists in that some items will not work while one is wearing gloves, while others are relegated to working only when the weapon is in the storage mode. Additionally, some items are made functional only when the operator is wearing (or in possession of) an ancillary piece of equipment; e.g., key, ring, or bracelet. Even the more intriguing items fall short in one or more ways. In summary, the question of whether or not their mechanical reliability (or operational usefulness) is adequate for the object intended remains an open one. Extensive testing is required prior to any truly meaningful assessment being made. Therefore, the panel recommends that these and other such candidate off-the-shelf items receive further testing by appropriate government activities. Moreover, emerging technologies should be sought after within government, Academe, and Industry. In light of these observations, a more ambitious conference is planned for the March 2001 time fame.

Shown next is the item by item listing, which includes their respective "pros" and "cons."

Armadillo [Gun Trigger Lock]

Positive attributes:

Low cost
Easy to use, easy to install, and easy to remove
Simple mechanical operation
Fits a variety of firearms but not all
Utilization as a storage device only
Good for transporting weapon

Negative attributes:

Not entirely reliable – with some effort one could fire the gun with the device installed – too easy to defeat if not properly installed
If the device was shaped for each specific gun, then maybe it could not be defeated.
When this mechanism was placed on the M9 pistol, and the lock locked, the gun could be fired.
It is possible to load some weapons with the lock in place
It takes too much time to make the weapon operational for use
Key can become lost or stolen
This device will not work on lever action rifles.
The device can be rotated and the trigger can then be pulled with a small tool, like a pen, and the gun will fire.
It is not one hundred percent reliable
Not applicable for operational use
Possible problem when attempting to bring the firearm into operation especially during times of high stress

Maglock [Push Button Trigger Lock]

Positive attributes:

Inexpensive
Mechanical device applicable to a variety of firearms
Easy to use - Easy to disengage for home use
Simple to operate
Reasonable construction
OK for storing the weapon
Works every-time
Common usage of the keypad (for a variety of applications) gives this system a "comfort level" with civil users
No key is required

Negative attributes:

Proper functioning of the device requires proper user installation
Effectiveness varies with different weapon types
Difficult to envision the use of this system in the dark and in direr situations
Capability could be improved with the use of a cable through the firing chamber and barrel
Item does not prevent the gun from being fired - item can be rotated and defeated – a string could be used to pull the trigger
Item works easier on revolvers, not so good for automatic weapons
Not a good concept for operational use
Simply does not work – easy to defeat
Does not fit well enough to prevent firing

Does not work on some cables - the optional cable would be required for some weapons
If this device was shaped for a specific weapon it may have provided adequate protection

MAGLOCK [Ring Activated Gun Lock]

Positive attributes:

Quick to use
Costly
Good idea if it works
This device has the potential to be a user only capable weapon

Negative attributes:

Unreliable function - does not work
In order to make it work, device had to be fiddled with for a long time
Ring does not always release the mechanism for the weapon to function
If a longer magnet is used inside of the weapon, it may make the mechanism release more repeatable
Too many factors could affect functioning
If it worked properly, it would be easy to use and not so easy to defeat
Can be defeated with a magnet in lieu of the ring – You can remove the item from the gun and the device can be fired - have to make it so the hand guards are not removable from the weapon
Works for only a right handed person
Very difficult to get this weapon to function with the device installed - magnet has to be very accurately placed in the handgrip for the device to work sometimes
Gun specific – works only for the COLT 45 1911A weapon
Not an all weather capability
Can only fire weapon with the hand with the ring on it – if this hand gets wounded – can not fire weapon from the other hand

Master 90 [Gun Lock]

Positive attributes:

Simple and easy to use
Mechanism is reliable
Affordable – inexpensive
Fairly Robust – good lock
Moderate deterrent
Good for home use - storage
Effective from stopping small children from firing the weapon
Locks the trigger well
Device can be placed behind the trigger on some weapons to prevent firing

Negative attributes:

With considerable manipulation, the weapon can be fired with the device installed
Teenagers will find a way to defeat this device
On some weapons – easy to defeat
Can be defeated by breaking pins
Cannot be used on all weapons
The one size fits all makes the device difficult to install
Not recommended for operational use

Mossberg Instant Access [Gun Safe]

Positive attributes:

Easy to use
No modification to weapon
Reliable
Portable
Quick access
Encapsulates entire weapon
Great all around mini-safe - for home and transportation of the weapon
Designed for easy mounting to a wall and floor – with additional mounting plates – can be transported from one location to another location
Great for home storage
Can be used to store valuables as well
One combination – multiple users
Will store a variety of weapons

Negative attributes:

Expensive
Weapon has to be in the safe to be effective
Heavy to carry
Not recommend for operational use
Long access time to acquire gun if for self – protection
Battery is required
Not all weapons can fit in this unit
Makes a noise when operating – may alert felon if within earshot
This mini safe could be stolen if not anchored properly to the wall of floor

Saf T Lok [Magazine Combination Lock]

Positive attributes:

Easy to use
Concept is good and works
May have application for storage

Negative attributes:

Does not really prevent firing of the weapon – only disables the magazine from functioning
Can be defeated
With the device installed in the weapon, and locked, one can load a round in the chamber and fire the weapon
Not durable
Hard to use
Difficult to Unlock
Device will have to be modified so that it will not allow the weapon to be fired with the magazine loaded

Saf T Lok [Revolver Kit Combination Lock]

Positive attributes:

Great device
Easy to use
Simple to use
Reliable
Positive lock
Quick to disarm
Good for storage
Gun will be damaged before it will violate the integrity of the locking system

Negative attributes:

Specific for a particular weapon
Can be defeated in minutes by unscrewing one screw and removing the grips
With a different fastener – this would be an effective device
Hard to use in less then ideal situations, for example, in the dark
Takes some time to unlock the weapon
Not recommended for operational use – once disengaged one must physically re-engage the lock

Security Locks [Pistol Box-Safe]

Positive attributes:

Simple to use
Easy to use
Reliable
Secure – home use - good for storage – other valuables
Provides basic weapon protection – wide variety of handguns
Completely encapsulates weapon
Good for child protection and safety at home
Positive mechanical action

Negative attributes:

Costly
Limited space
Just a box
Not recommended for operational use – law enforcement and military applications
Weapon is not available if needed for immediate use
Time from safe to arm too long
Weapon must be in the safe to be effective
Entire box can be stolen – with weapon inside
Need to be anchored to rigid part of the house
It does not respond to NJIT metric of users only operation, that is, a direct use

Security Locks [Gun Safes]

Positive attributes:

Simple to use
Easy to use
Reliable
Very secure – not for the average user – can be used for valuables
Great for long term storage
Good for child safety
Easy to use
Basic gun safe box
Multiple guns can be stored
Completely encapsulates the weapon to deny access

Negative attributes:

Expensive
Too Heavy - not portable – hard to pick up and carry
Large in size – takes up a lot of room
Because of its weight have to be careful of where to locate item in the house
Combination lock could be difficult in a stressful situation to open
Weapon must be in the safe to be an effective deterrent
Not applicable for operational use
Not specifically responsive to the NJIT metric of user only operation of a fire-arm

Security Locks [Master Cable Lock]

Positive attributes:

Easy to use
Gun owner will probably use this device for storage of the weapon
Simple operation
Reliable

Rugged
Effective
Physically blocks the barrel or the operation of the slide or cylinder
Inexpensive
No modification to the weapon is required
Can be used on all weapons

Negative attributes:

Weapon can be stolen unless the cable and weapon are anchored to the house
Easy to defeat – cut the cable with bolt cutters
Not recommended for operational use
Time to go from safe to arm is longer than desired

Security Locks CCL [Cable Lock]

Positive attributes:

Easy to use by the homeowner
Simple to operate
Rugged
Effective
Inexpensive
Good for storage
Can be used on a number of weapons
No modification to the weapon is necessary
Positively blocks the operation of the weapon

Negative attributes:

Weapon can be stolen unless cable and weapon are anchored to the house
Easily defeated - can be defeated by cutting cable with bolt cutters
Teenagers can defeat this mechanism
Not recommended for operational use
Time to move from safe to arm is longer then desired

Fire Armor [Lockable Clam Shell]

Positive attributes:

Easy to use
Simple to use
Fits a variety of weapons, handguns and rifles
Very secure
Affords rapid access
Good for storing the device
Prevents access to the action – covers the major components necessary to operate and load the weapon
Can have your weapon loaded, ready to go, locked in this device

Negative attributes:

Weapon can be stolen locked in this device if this device is not anchored to the house
If the device is stolen, the device could be defeated
It is not really responsive to the NJIT metric – that the firearm be usable only to the authorized user
Will not fit all models of weapons
Weapon must be in the "clamshell" to secure weapon from firing
Not recommended for operational use

Phalanxlash [Locking Holster]

Positive attributes:

Simple to use
Robust - durable
Easy to use
Quick acting
Good for carrying weapon
It encloses all the parts of the weapon that function

Negative attributes:

Expensive
Gun must be unloaded to be returned to holster
Good for only automatic weapon operational use
Forces unnatural weapon draw motion
Additional time required to holster the weapon
Noise associated with use - can not nonchalantly put weapon into action
Locked and cocked mode may not be acceptable for law enforcement applications
Round is in the chamber after the gun is removed from the holster
Weapon and holster can be stolen
This device can be defeated, only need to know how it operates
Only works on a limited number of guns

Saf T Blok [External Trigger Lock]

Positive attributes:

Very simple to use
Very easy to use
Very reliable
Can be used to store the weapon

Negative attributes:

Only works on Glock handguns
The block can be punched out
Not really applicable to the NJIT goals
Not effective to stop children from pushing out block behind trigger
Limited operational use

Speed Release [Electronic Trigger Lock]

Positive attributes:

Easy to use
Fast to use
Inexpensive
Good for transporting weapon
Good for storage
Covers the trigger and trigger guard
Lighted numbers – easier to use in the dark

Negative attributes:

Weapon can be stolen with the lock
Easy to defeat – does not secure firearms to a structure
Not applicable for operational use
Takes time to remove device to use weapon
Probably has the same faults as other trigger locks, with some sort of manipulation, can make the weapon function

iGun [Magnetic Ring Unlocking Device]

Positive attributes:

Does have application for the homeowner
Possible application for law enforcement
Good for storage
Personal ID for the weapon by the use of the special ring

Negative attributes:

Not all weather
Is it reliable in all situations?
Very complex inner workings
Not very robust
Does not stand up well to abuse - poor shock response
Good for operational use if it works

EtronX [Electronic Ignition Rifle System]

Positive attributes:

- Simple to operate
- Very secure
- Tamper proof
- Very positive properties
- Many safeguards in this system
- Has to have a key to operate
- Good for storage

Negative attributes:

- Very expensive
- Requires a battery
- Some application to operational use
- Reliability of the electronics in this weapon is in question
- Only one weapon is available with this system – a rifle
- System is incorporated into only one weapon – can not be applied to another make or model
- System is designed for improved accuracy first, safety second
- Special ammunition required – electronic primed ammunition
- Cannot fire conventional ammunition
- Can hot-wiring or other electromagnetic means defeat this system?

Taurus [Key Actuated Key Mechanism]

Positive attributes:

- Very secure system
- Can upgrade older Taurus weapons inexpensively
- Key is required
- Good for storage

Negative attributes:

- Limited to Taurus weapons only
- Cannot be retrofitted to other makes or models
- Increased cost for this weapon as compared to other weapons with out this system
- Some application to operational use
- Homeowner may place key and weapon in same location

EVALUATION OF ITEMS: HARDWARE AND INFORMATIONAL

The following information was presented by Lucian Sadowski, CCAC, ARDEC and are presented in this report in viewgraph format.

Personalized Weapons Technology Project

Evaluation Process

There is a total of 18 items to evaluate

- 7 - Hardware
- 11 - Information

Each item will be presented one at a time

You will have a chance to evaluate this item

Fill out the evaluation form

Personalized Weapons Technology Project

Hardware

Armadillo $ 6.95

MAGLOC
- Trigger Lock $ 18.00
- Ring Lock $ 75.50

Master 90 $ 9.73

Mossberg $ 219.00 to $ 239.00

Saf T Lok
- Magazine Lock $ 89.95
- Revolver Lock $ 69.95

Costs of these devices as of October 17, 2000

Information

securitylocks
- Pistol Box $ 153.00
- Gun Safes $ 531.00 to $ 1,606.50
- Cable Lock $ 10.21 (Key)
- Cable Lock $ 12.99 (Combination)

FIREARMOUR $124.50

PHALANX LASH $169.00

Saf T Blok $ 19.95

Speed Release $ 35.00

iGUN $ 500.00

EtronX $ 1999.00

TAURUS Part of their Weapon

Personalized Weapons Technology Project

Weapons which will be used to evaluate the hardware

Beretta 92 - M9 Pistol

Colt 1911A1 - M1911A1 Pistol

Colt Caliber .38 - Revolver

Smith and Wesson Caliber .38 - J Frame Revolver

Remington 12 Gauge Shotgun - Model 870

Personalized Weapons Technology Project
Hardware to Evaluate

Company	Description	Further Details
Armadillo	Gun Trigger Lock	Key Lock Pistols, Rifles, Shot Guns
MAGLOC	Push Button Trigger Lock	Mechanical Key Pad Pistols, Rifles, Shot Guns
MAGLOC	Ring Activated Gun Lock	Magnetic Ring Colt 1911A1 Pistol
Master 90	Gun Lock	Key Lock Pistols, Rifles, Shot Guns

Personalized Weapons Technology Project

Hardware to Evaluate

Company	Description	Further Details
Mossberg	Instant Access Gun Safe Combination Electric Lock	Pistol Gun Safe
Saf T Lok	Magazine Combination Lock	Beretta 92
Saf T Lok	Revolver Kit Combination Lock	Smith and Wesson J-Frame

Personalized Weapons Technology Project
Information to Evaluate

Company	Description
securitylocks	- Pistol Box - Push Button Lock - Gun Safes - Combination Lock
securitylocks	- Master Cable Lock - Key Lock - CCL Cable Lock - Combination Lock
FIREARMOUR	"Lockable Clam Shell" Mechanical Combination Lock
PHALANX LASH	Automatic Locking and Loading Holster

Personalized Weapons Technology Project
Information to Evaluate

Company	Description
Saf T Blok	External trigger lock - Mechanical Combination Lock
Speed Release	Electronic Trigger Lock - Lighted Key Pad
iGun	Magnetic Ring Unblocks the Trigger
EtronX	Electronic Ignition Rifle System - Key operated Electric Primer - Ammunition
TAURUS	Insert a key into the trigger mechanism. Key locks the action Prevents the hammer and trigger from moving.

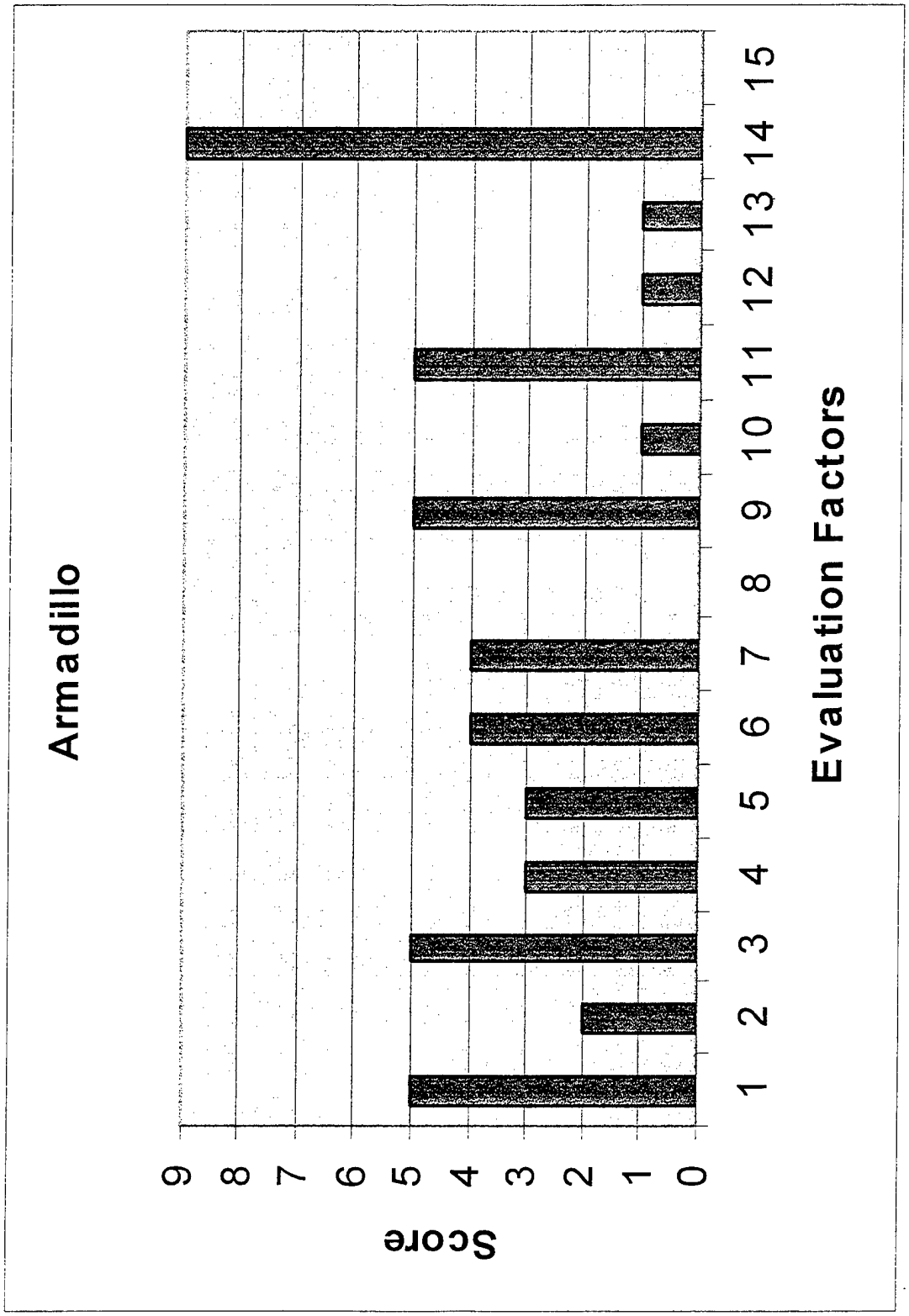
Results of the Evaluations

1. Histograms showing
   - Each item scores against all 15 evaluation factors

2. Histograms showing
   - Each evaluation factor and how each of the 18 items scored

3. Summary of these Evaluations

Please Note: Evaluation Factor 15, which required a yes or no answer,
1 denotes a Yes and 0 denotes a No


Armadillo
Score
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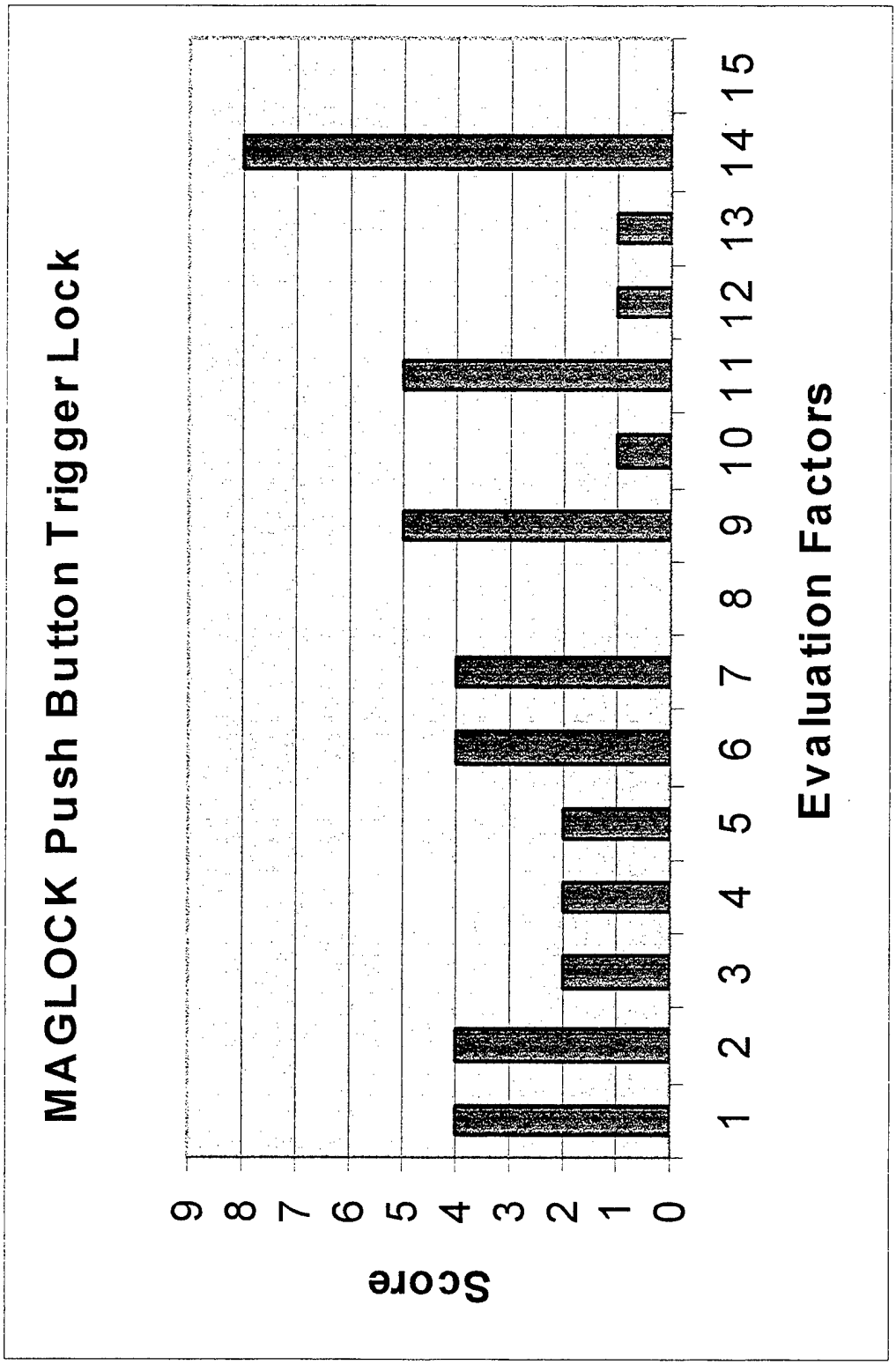
Evaluation Factors


MAGLOCK Push Button Trigger Lock
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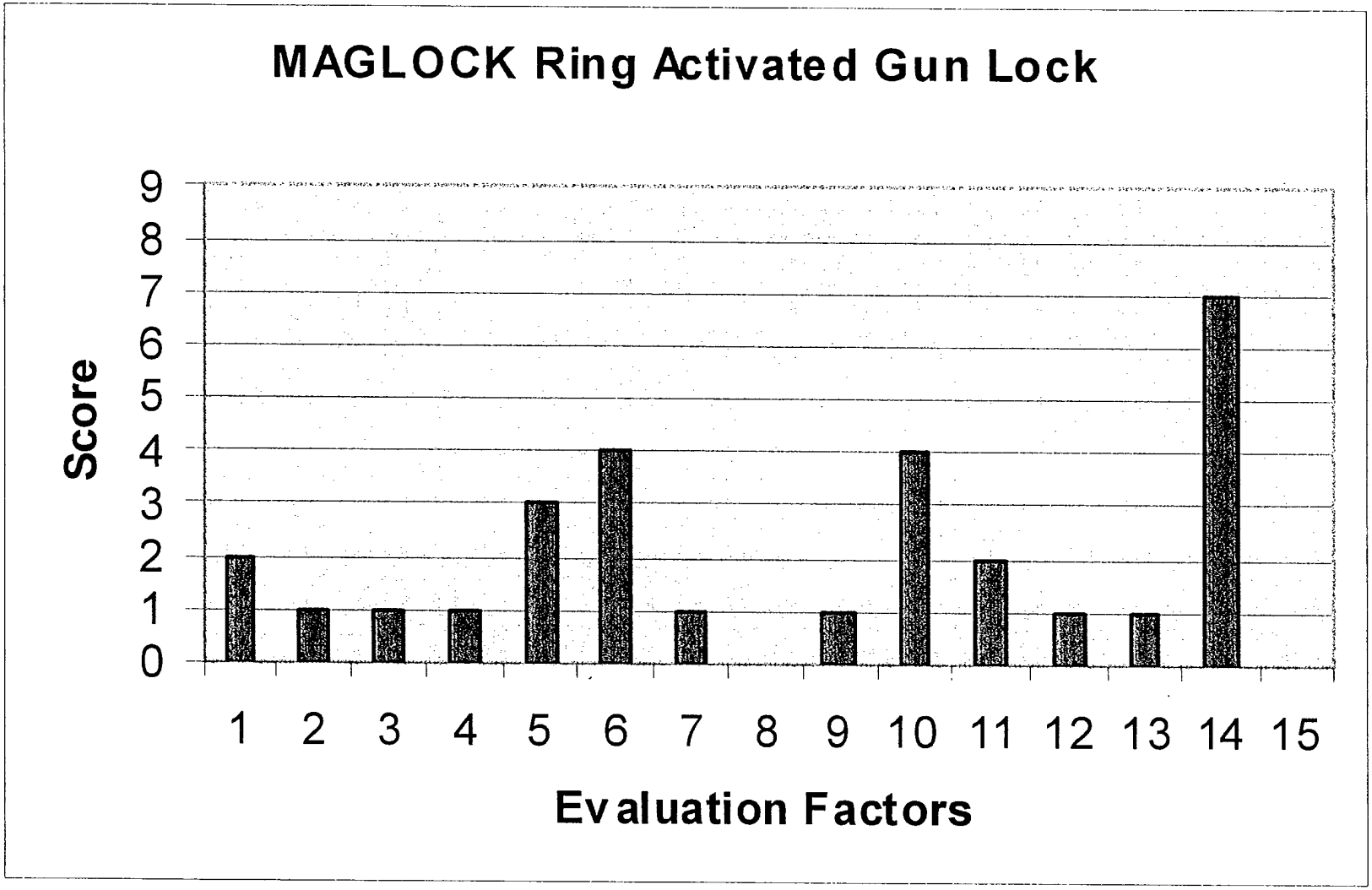
Evaluation Factors


MAGLOCK Ring Activated Gun Lock
Score
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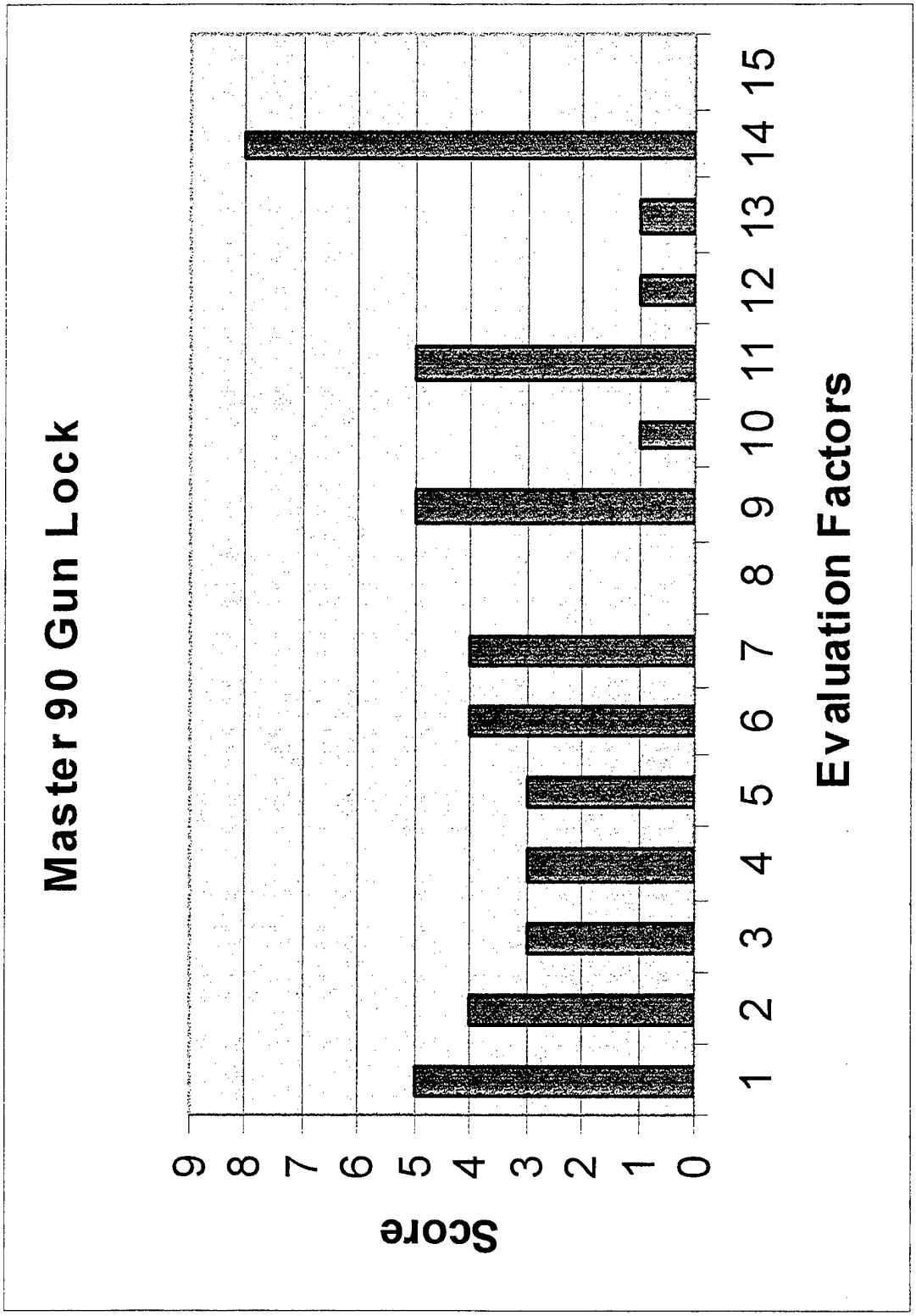
Evaluation Factors


Master 90 Gun Lock
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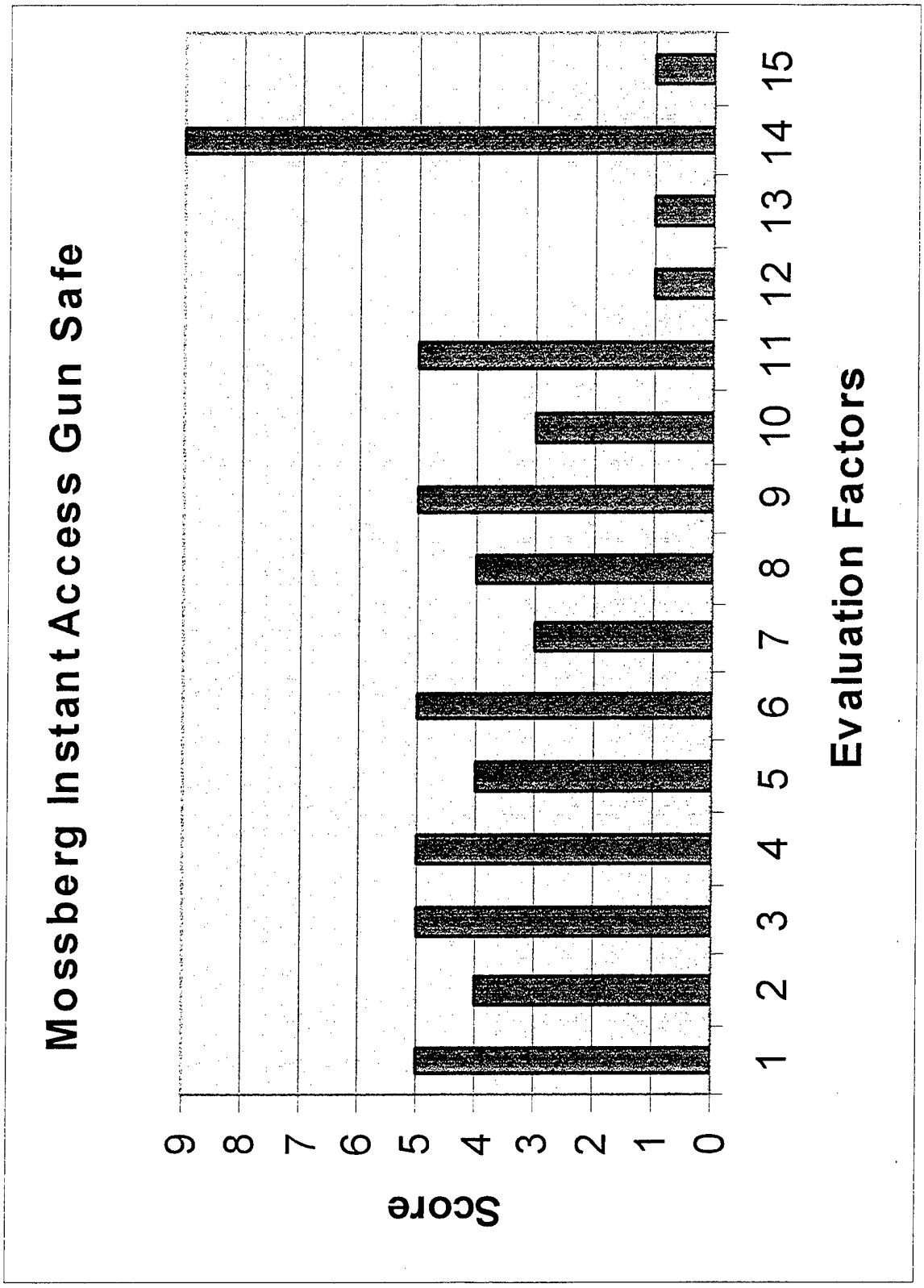
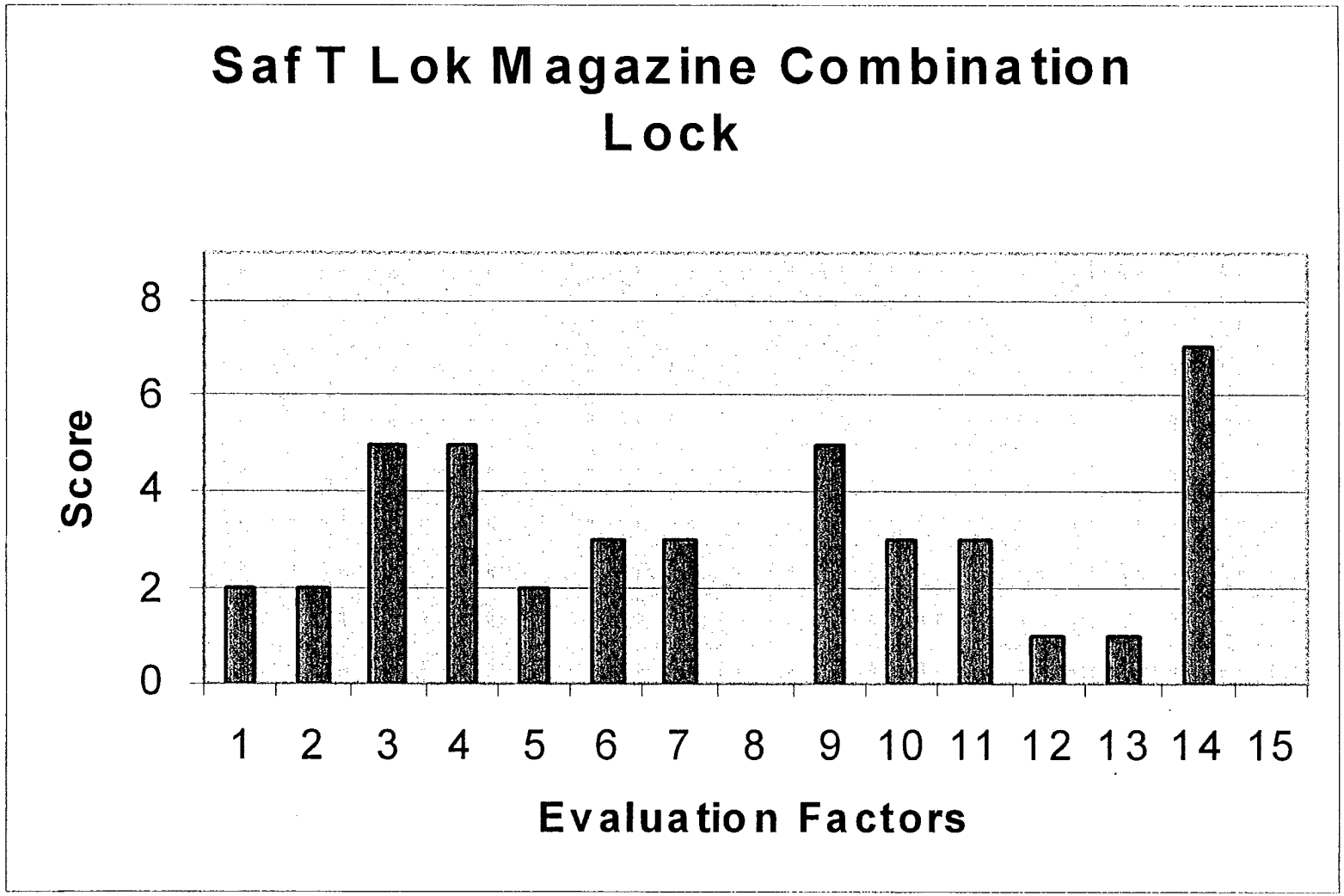
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Evaluation Factors


Mossberg Instant Access Gun Safe
Score
0
1
2
3
4
5
6
7
8
9
Evaluation Factors
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


Saf T Lok Magazine Combination Lock
Score
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2
4
6
8
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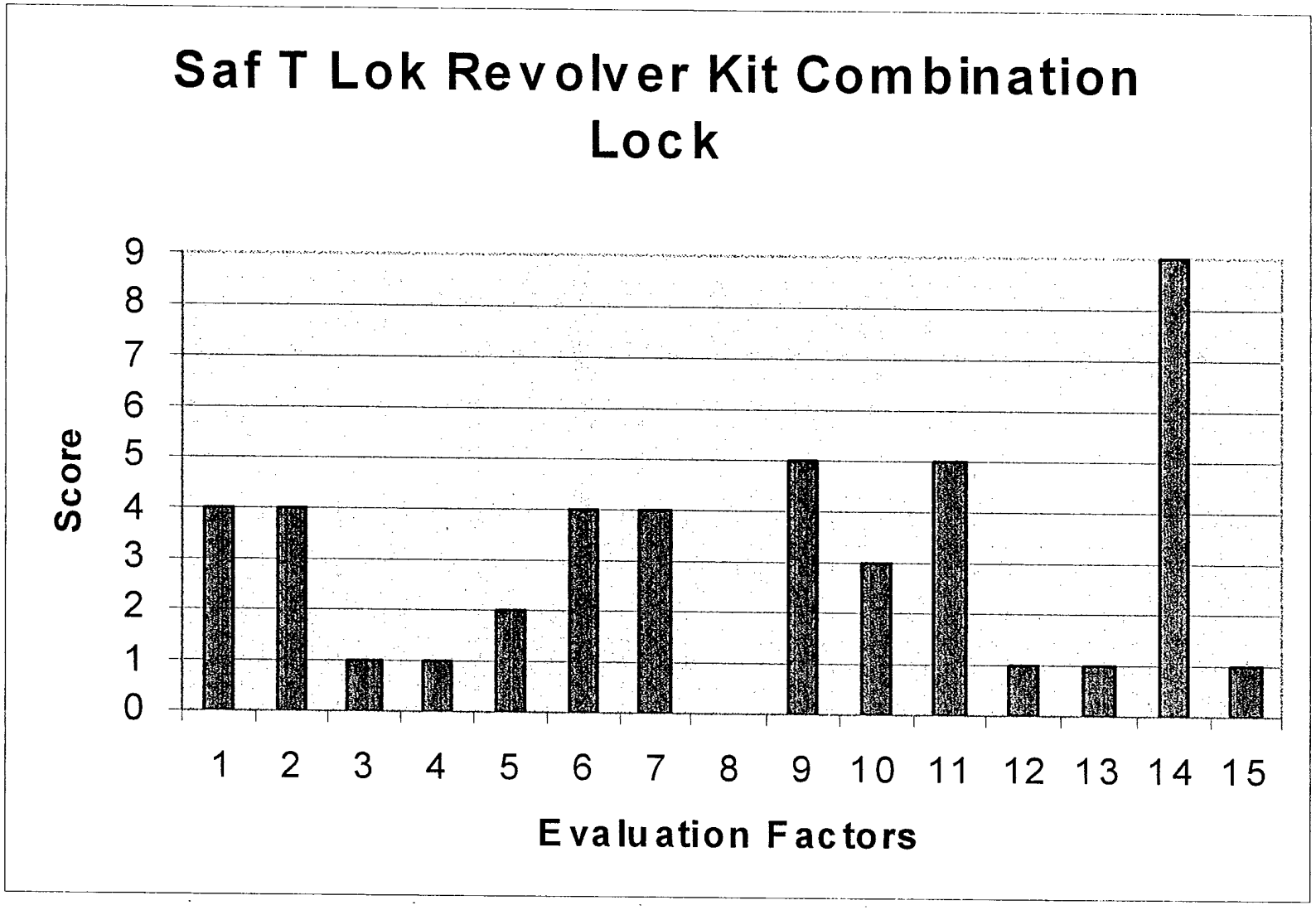
Evaluation Factors


Saf T Lok Revolver Kit Combination Lock
Score
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5
6
7
8
9
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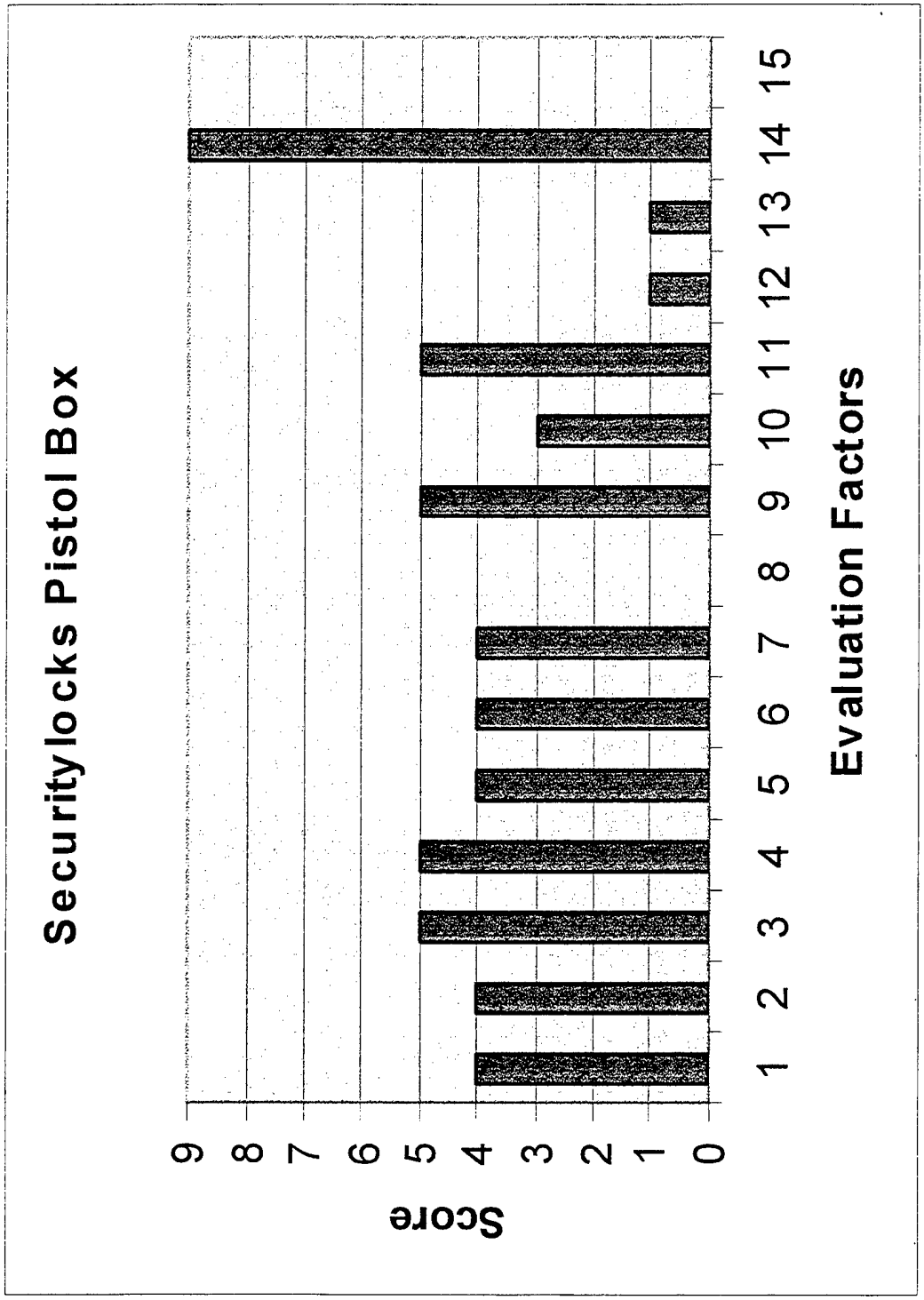
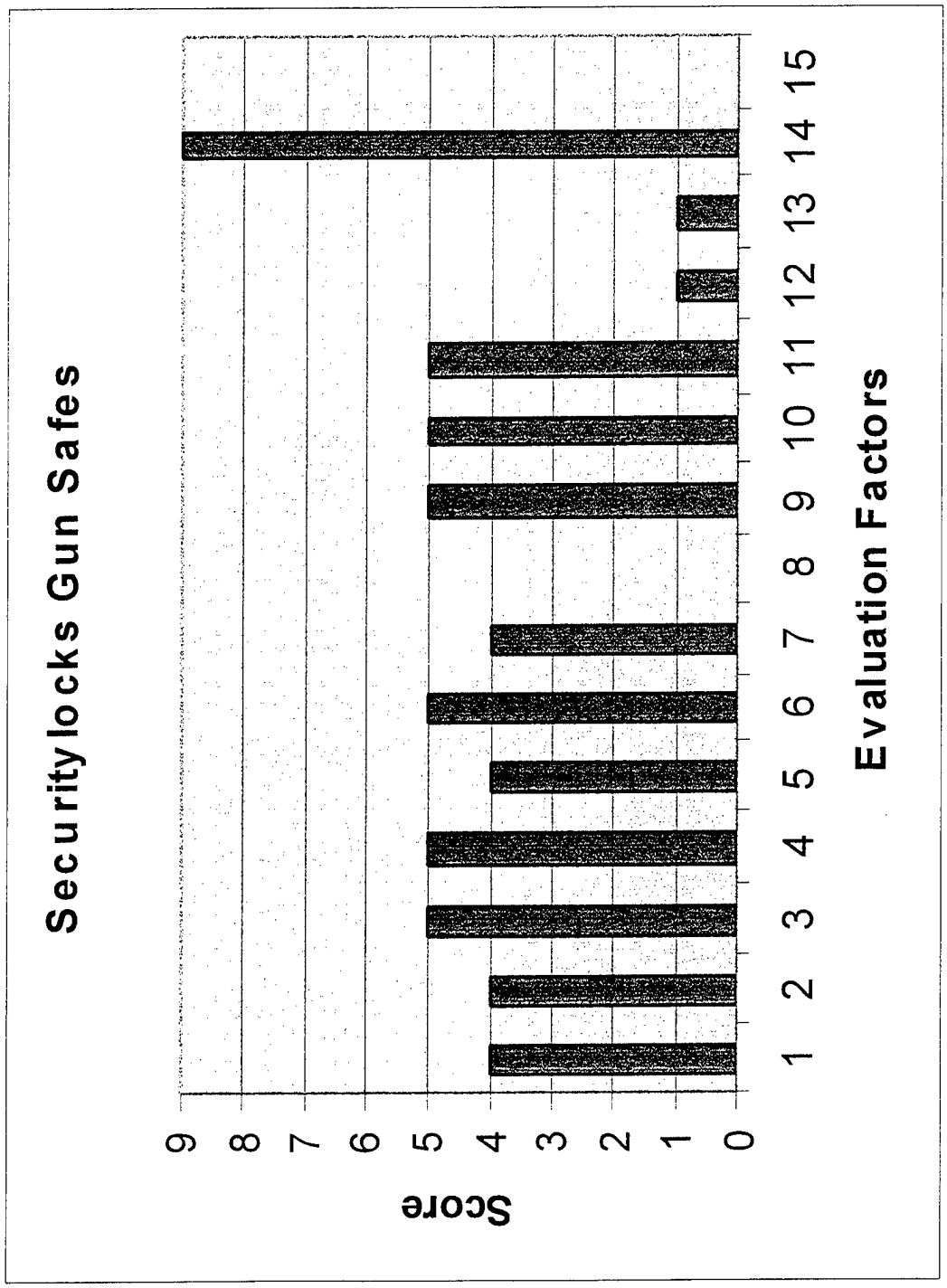
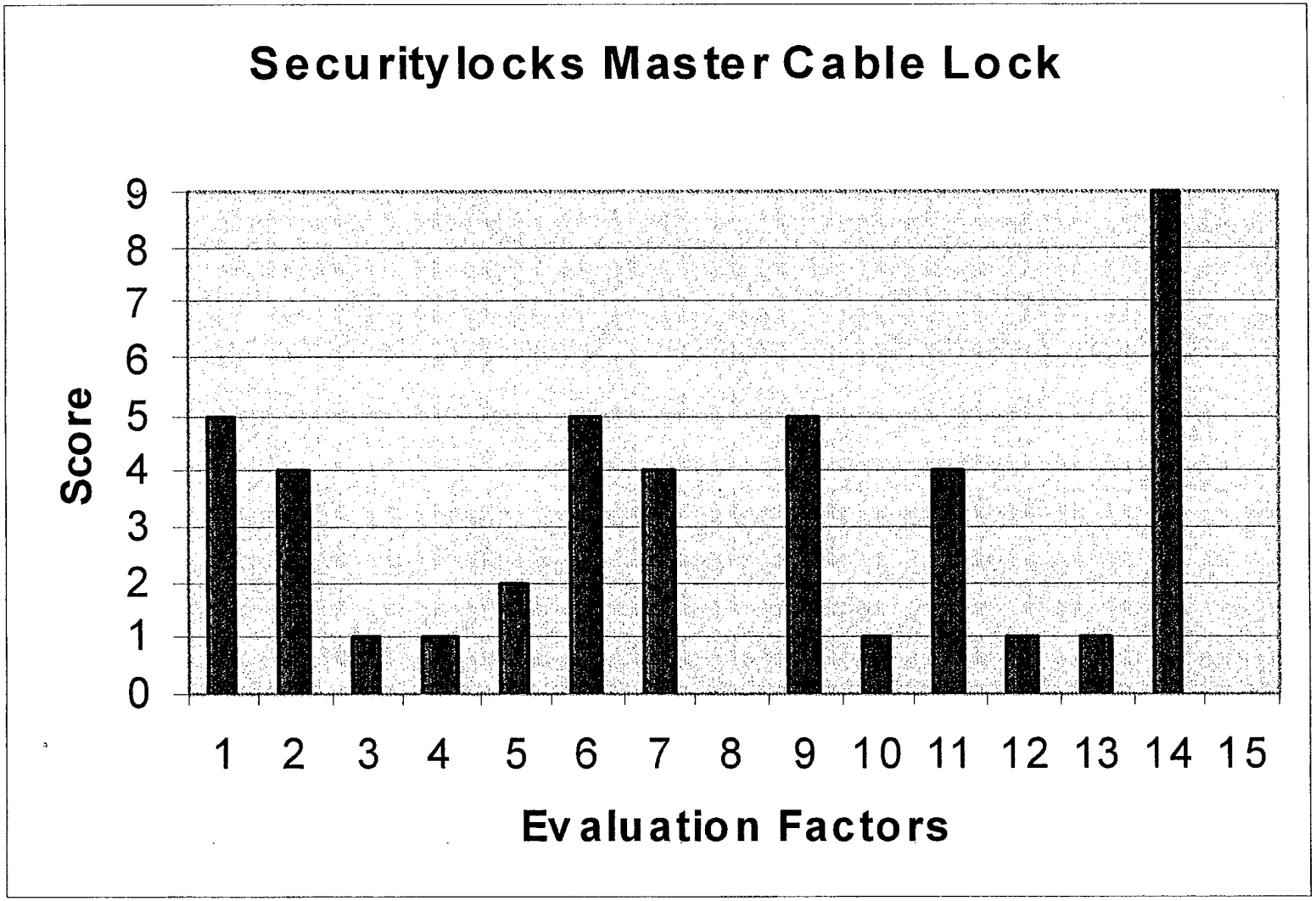
Evaluation Factors


Securitylocks Pistol Box
Score
0
1
2
3
4
5
6
7
8
9
Evaluation Factors
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


Securitylocks Gun Safes
Score
0
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Evaluation Factors


Securitylocks Master Cable Lock
Score
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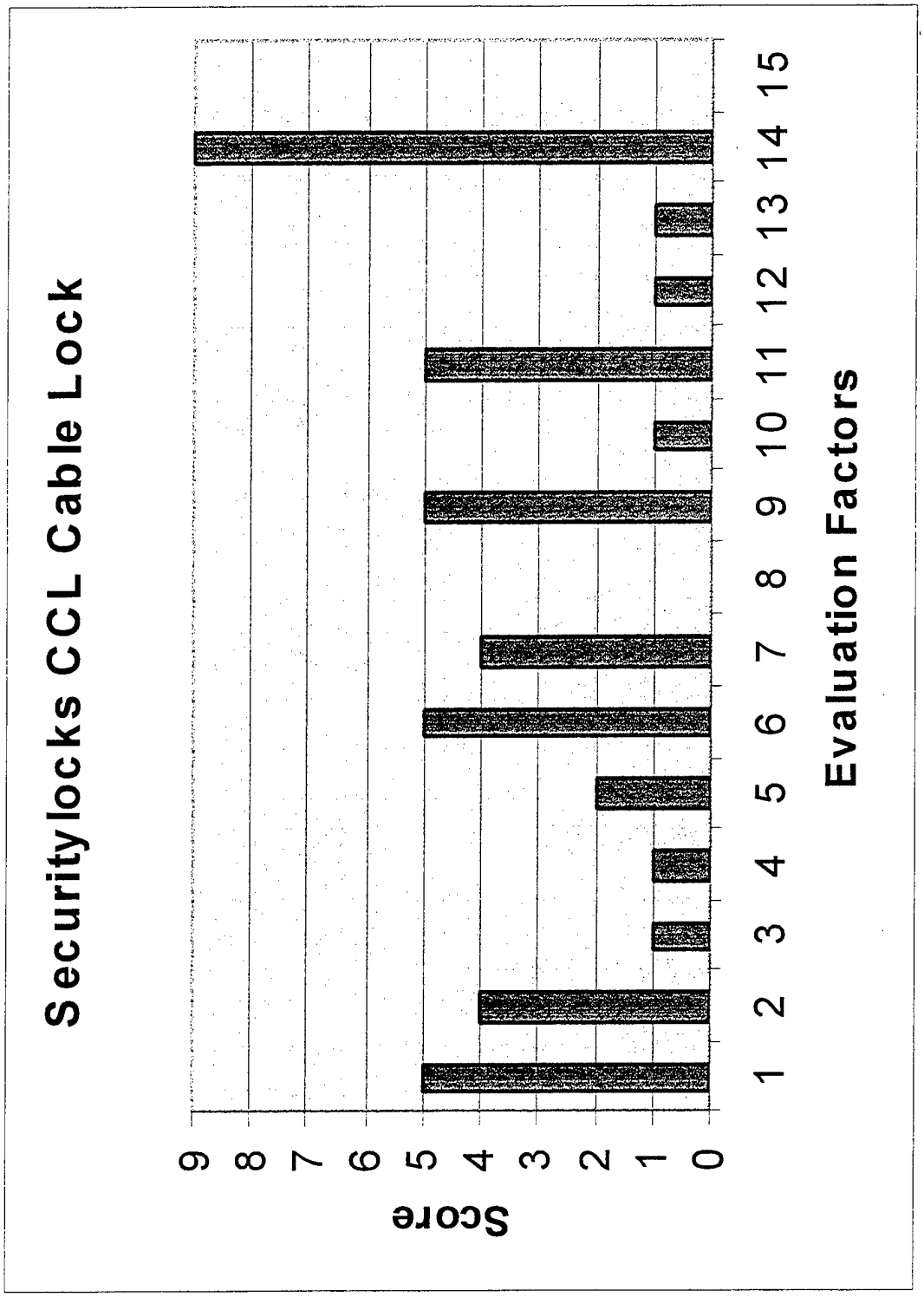
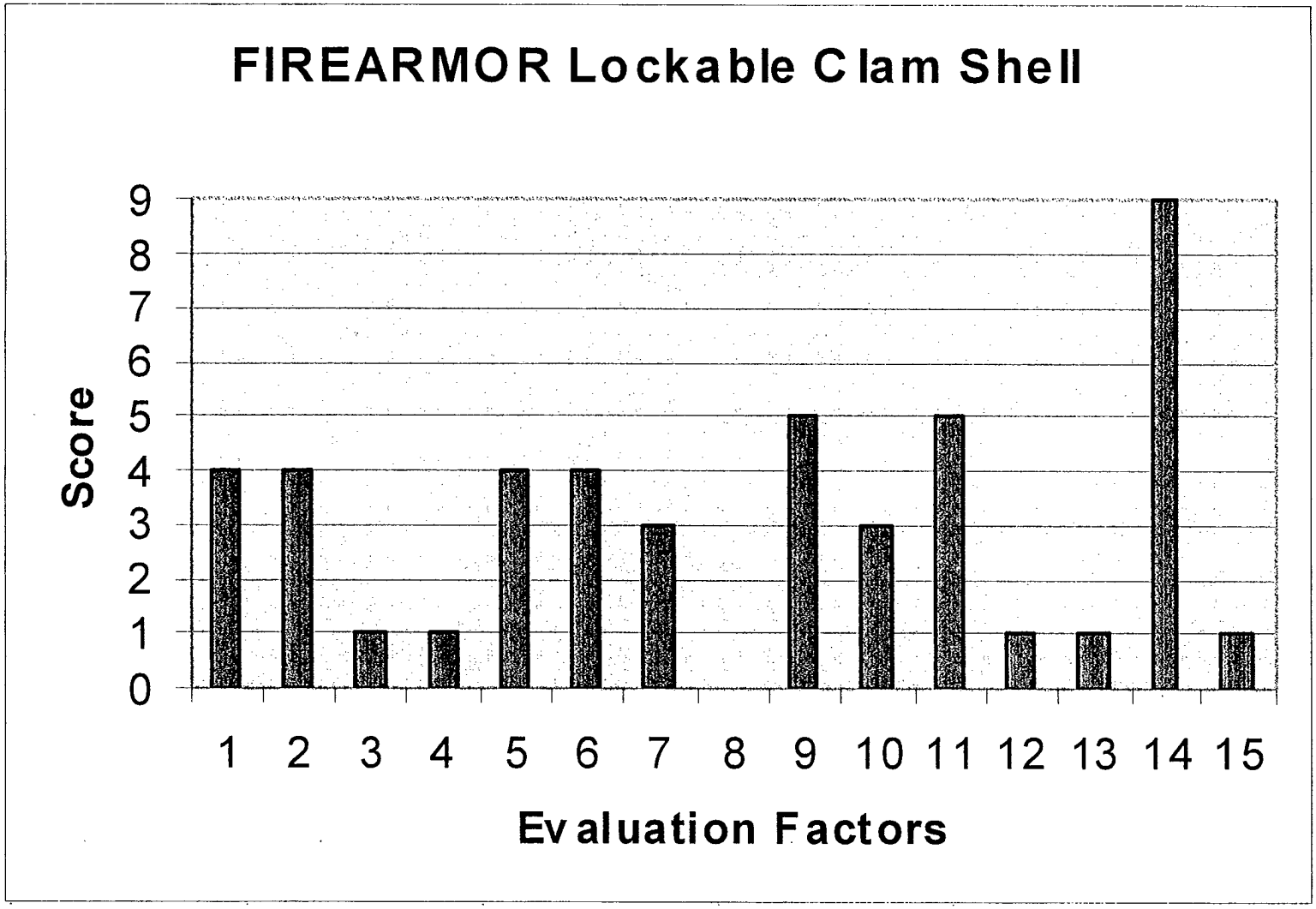
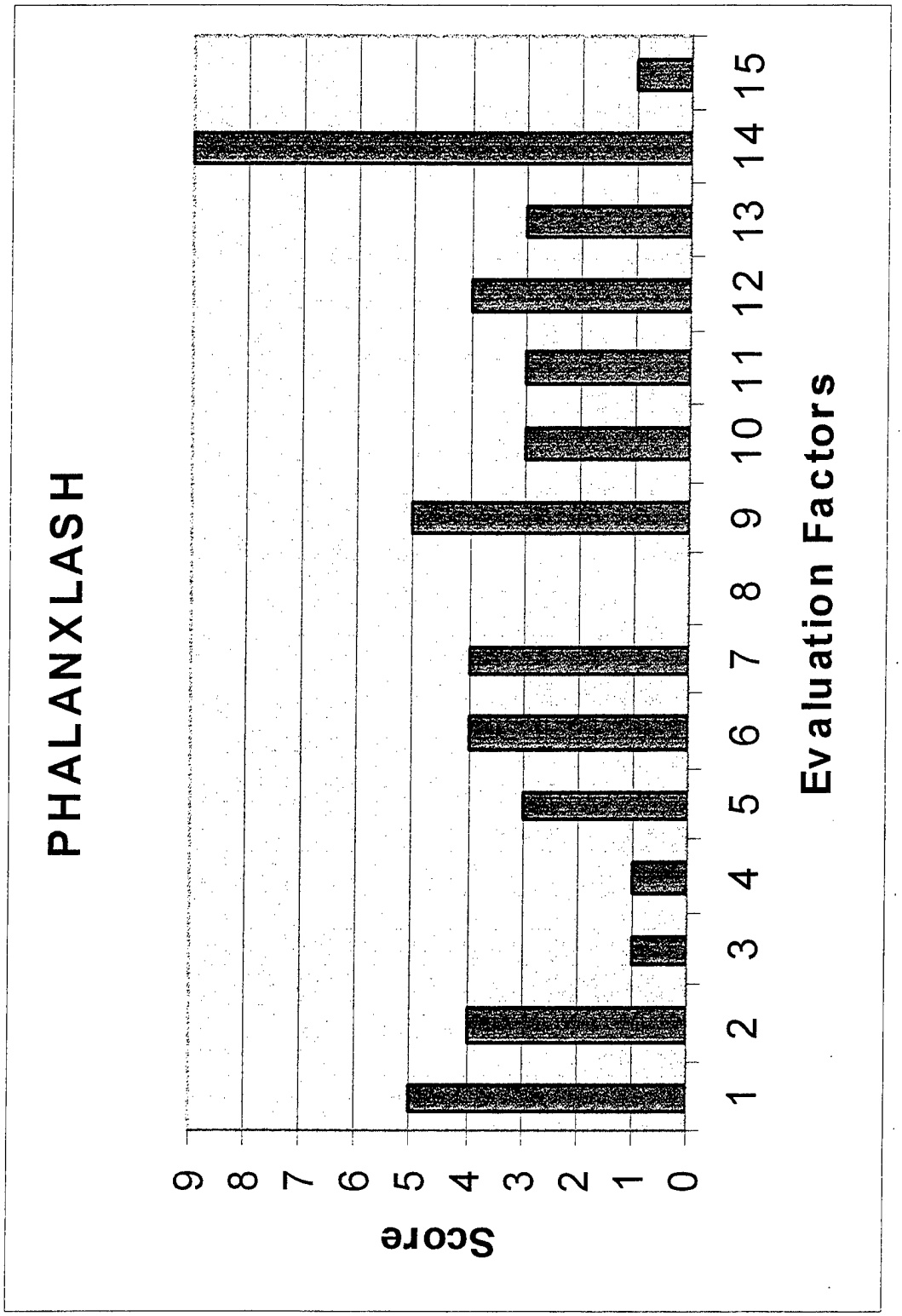
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Evaluation Factors


Securitylocks CCL Cable Lock
Score
0
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Evaluation Factors


FIREARMOR Lockable Clam Shell
Score
0
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Evaluation Factors


PHALANXLASH
Score
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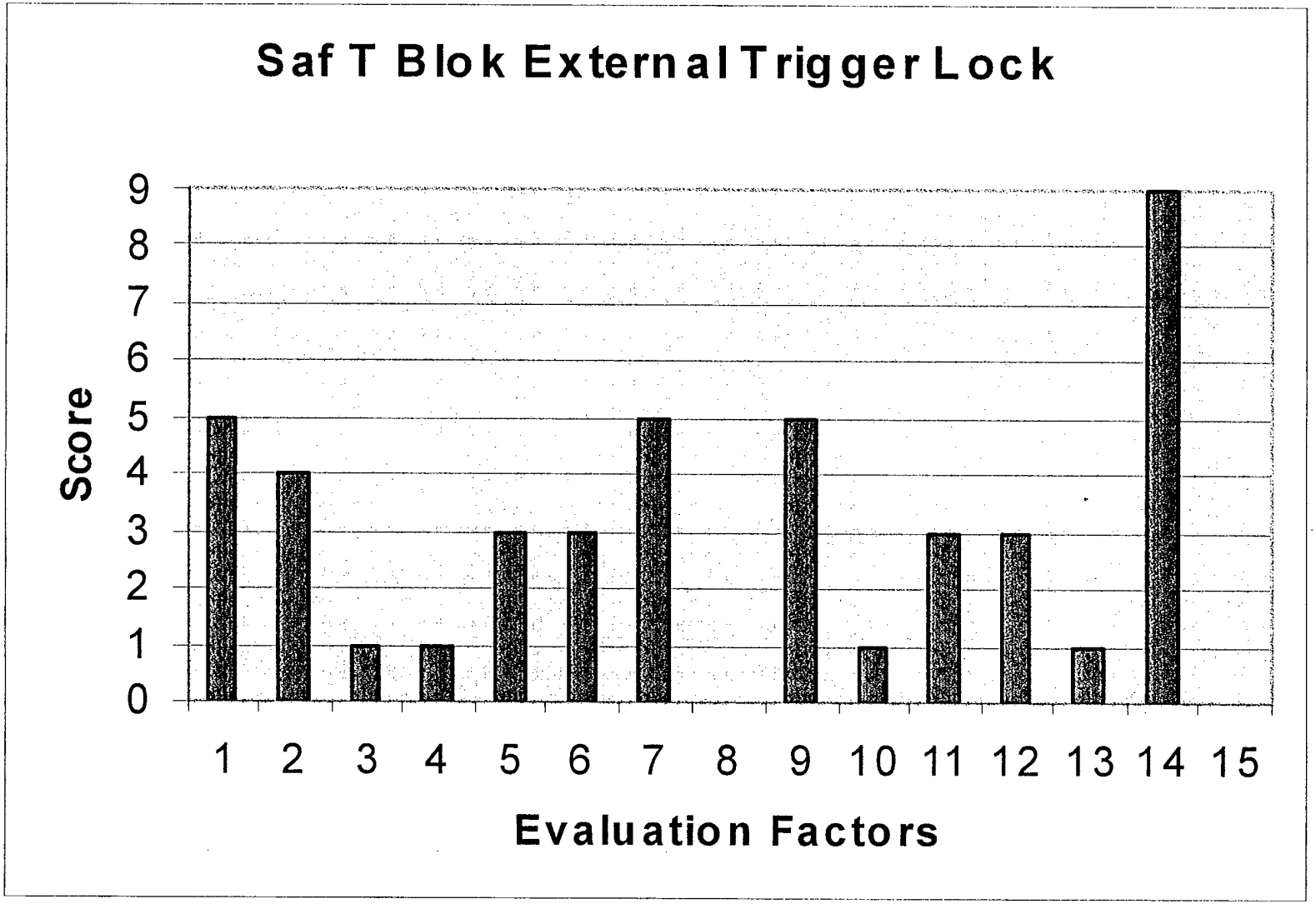
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Evaluation Factors


Saf T Blok External Trigger Lock
Score
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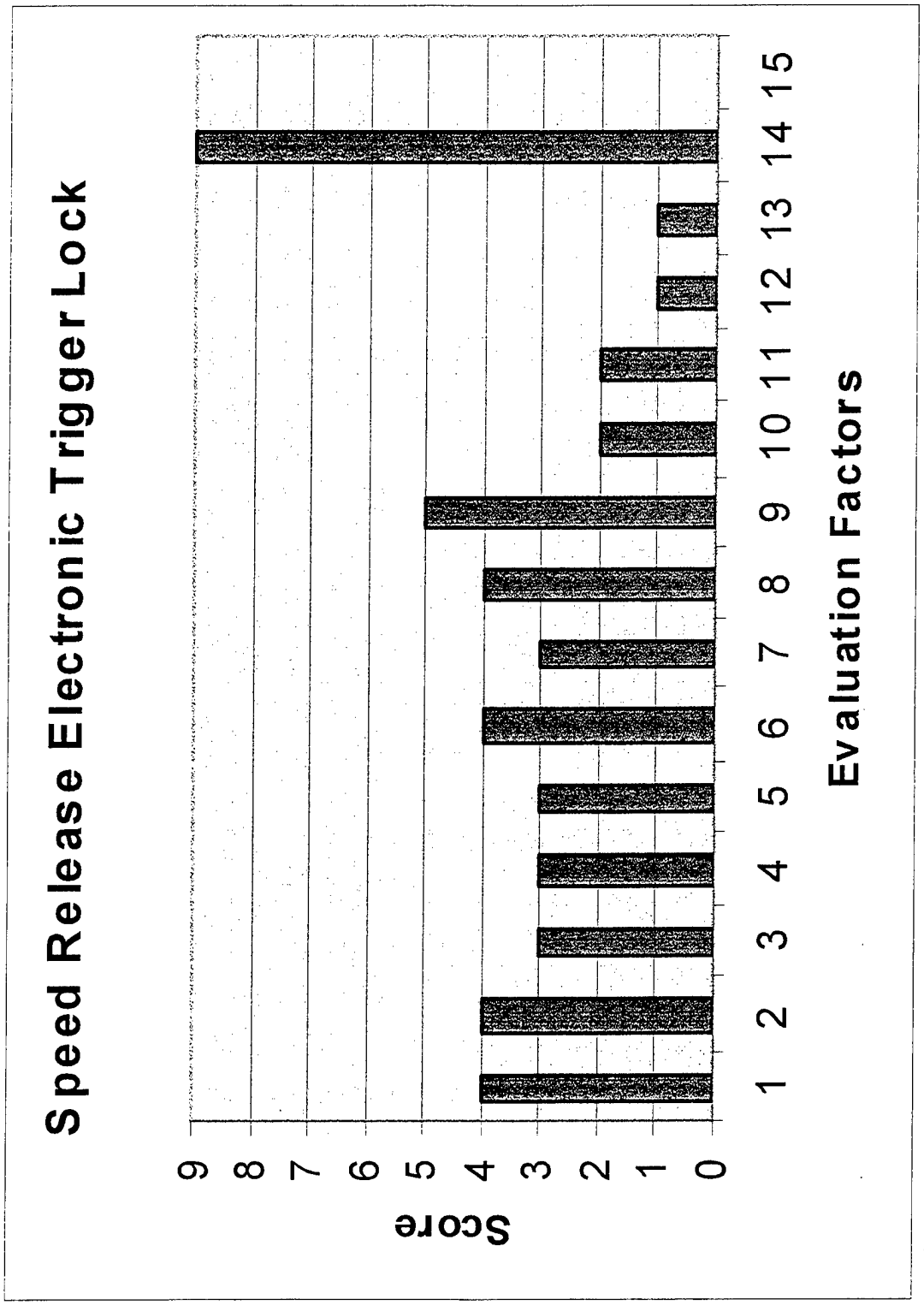
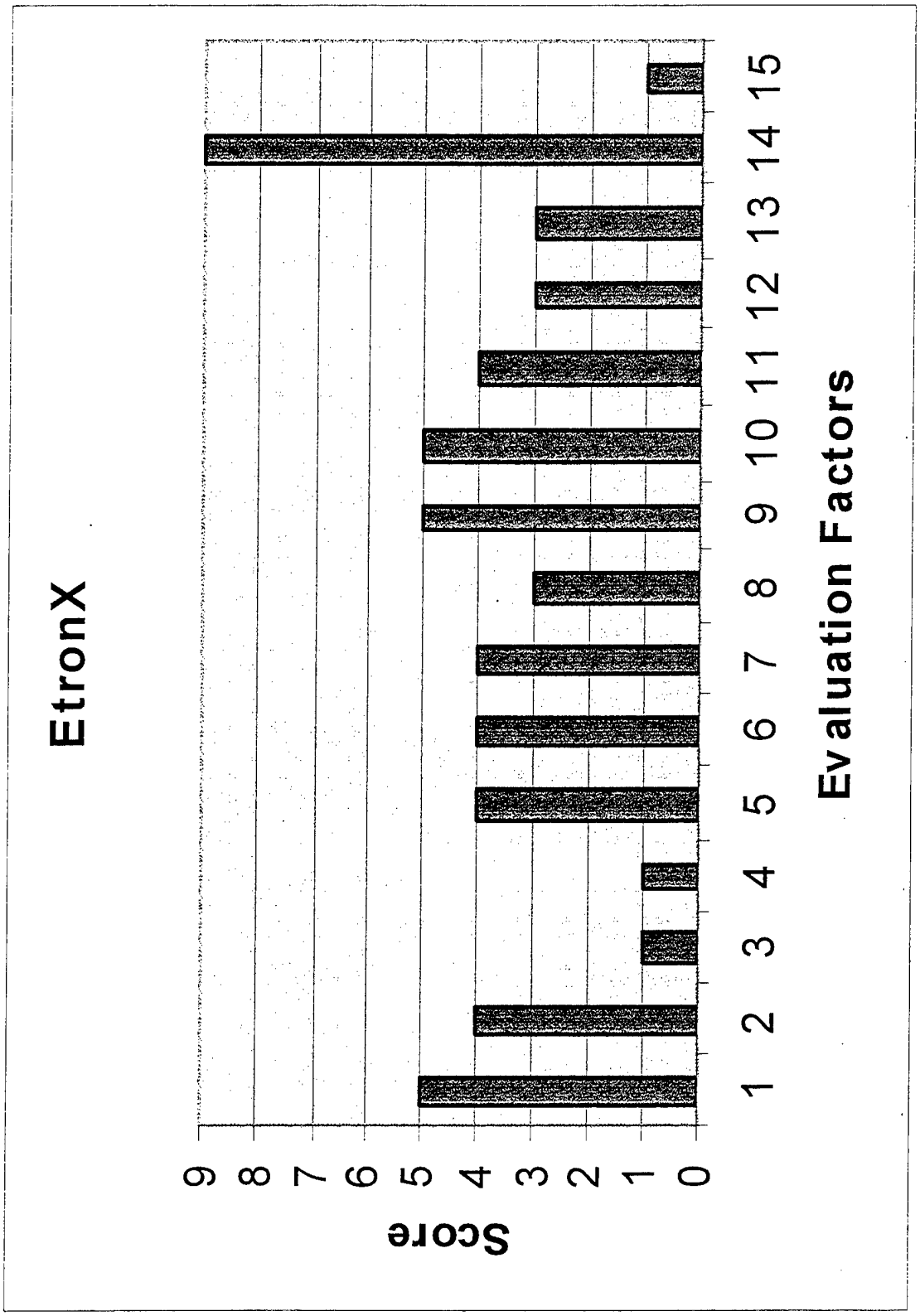
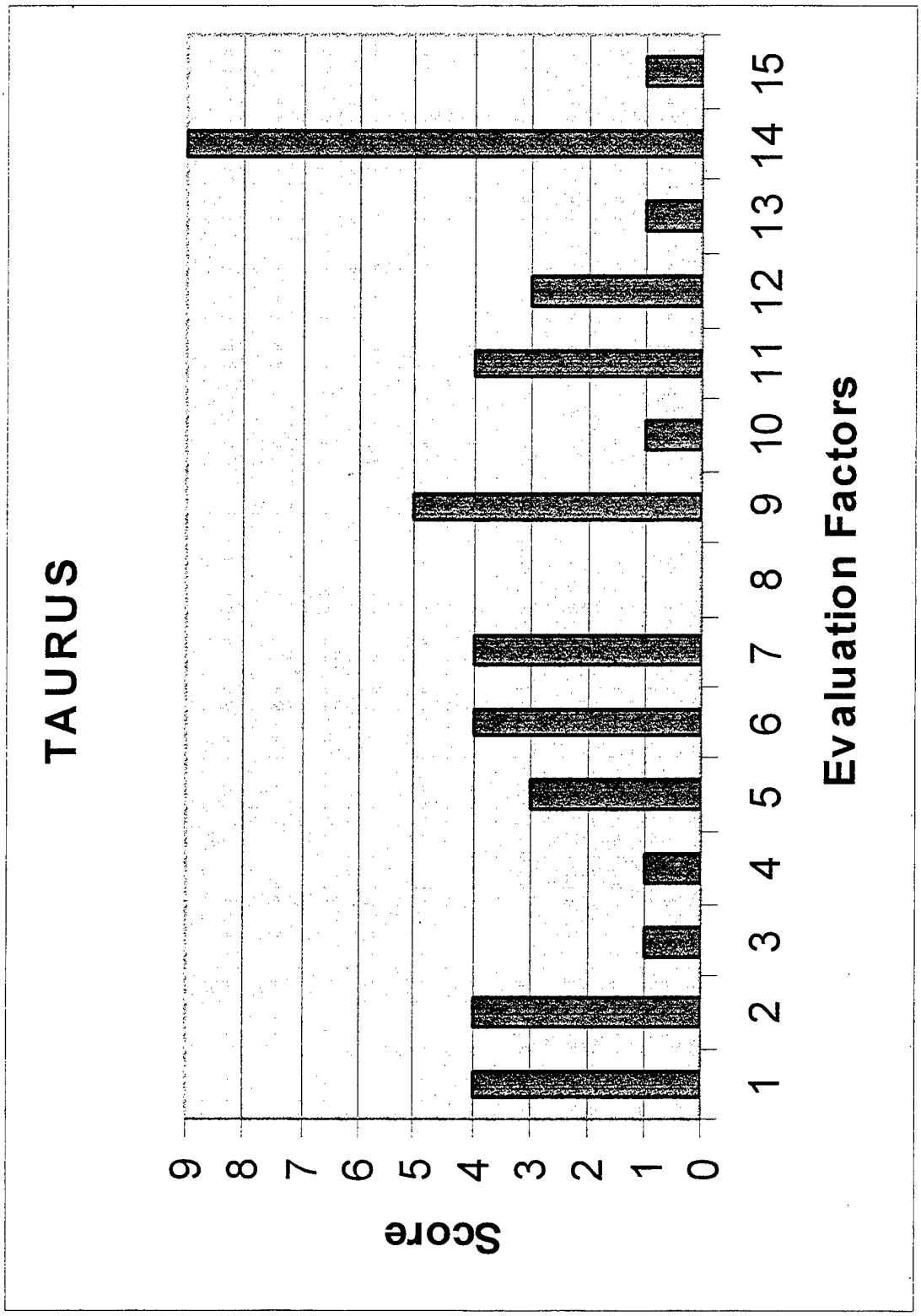
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Evaluation Factors

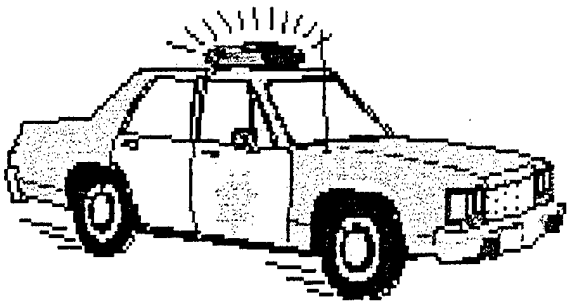

Speed Release Electronic Trigger Lock
Score
0
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Evaluation Factors


iGun
Score
0
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Evaluation Factors


EtronX
Score
0
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Evaluation Factors


TAURUS
Score
0
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Evaluation Factors

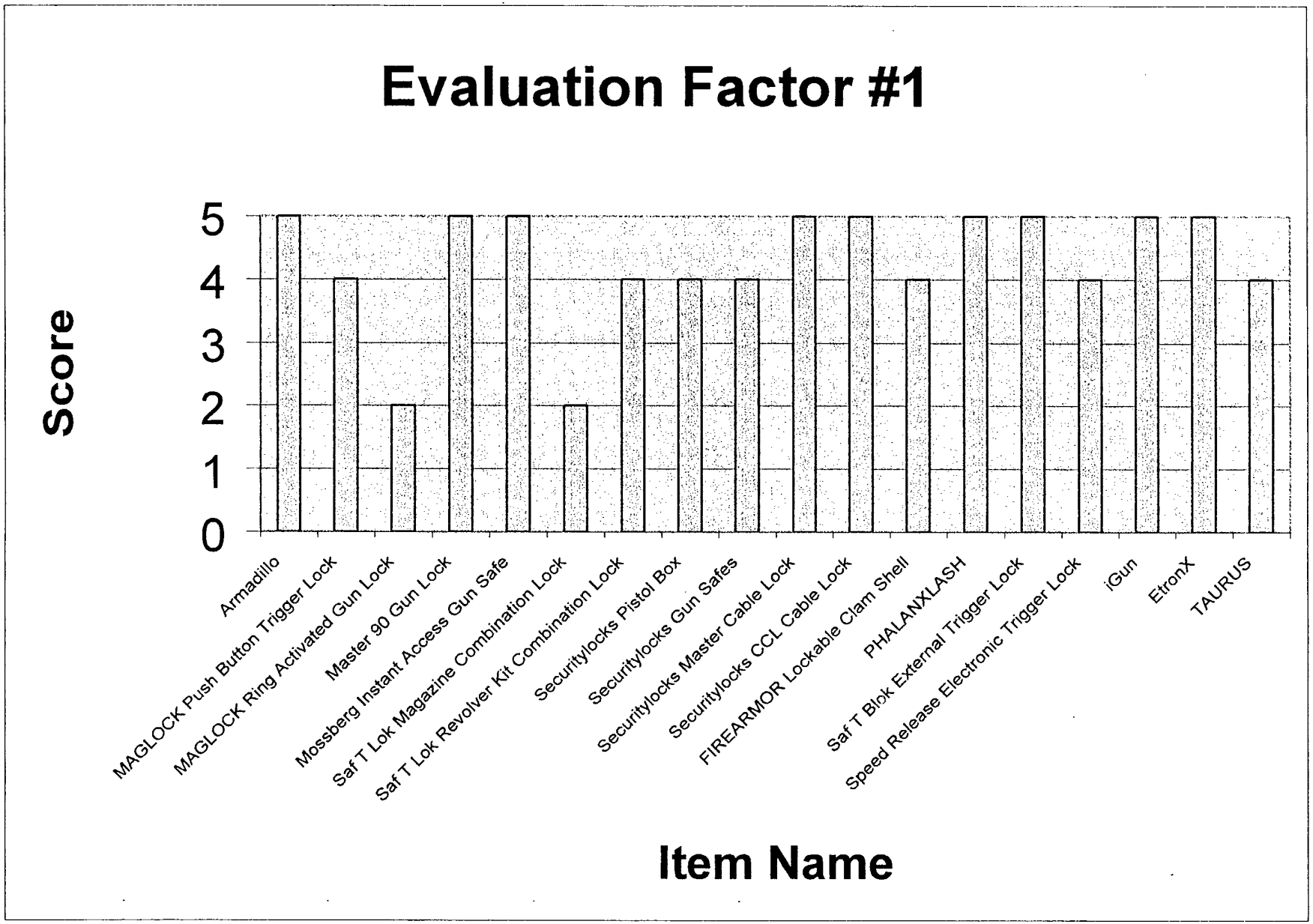
Evaluation of Items

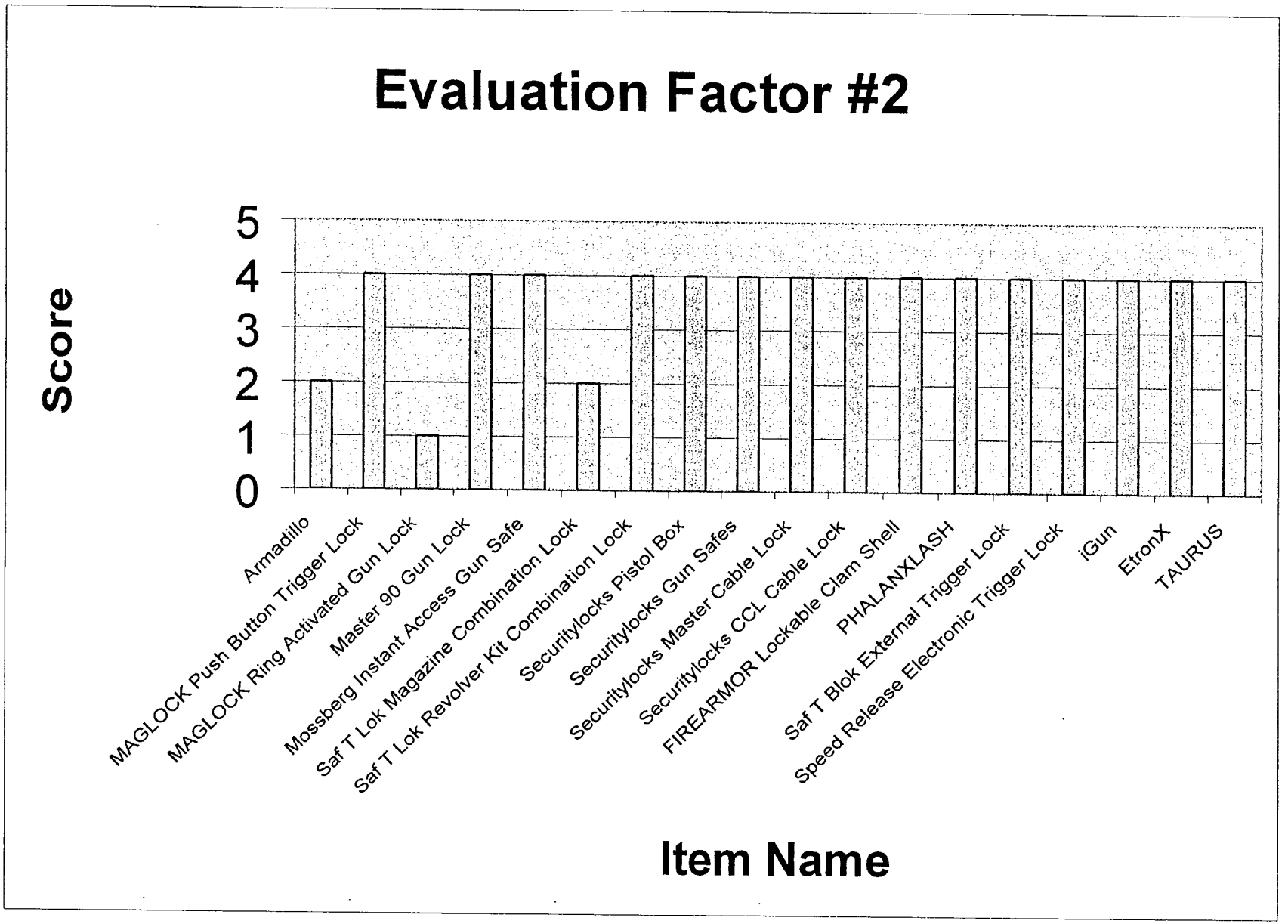


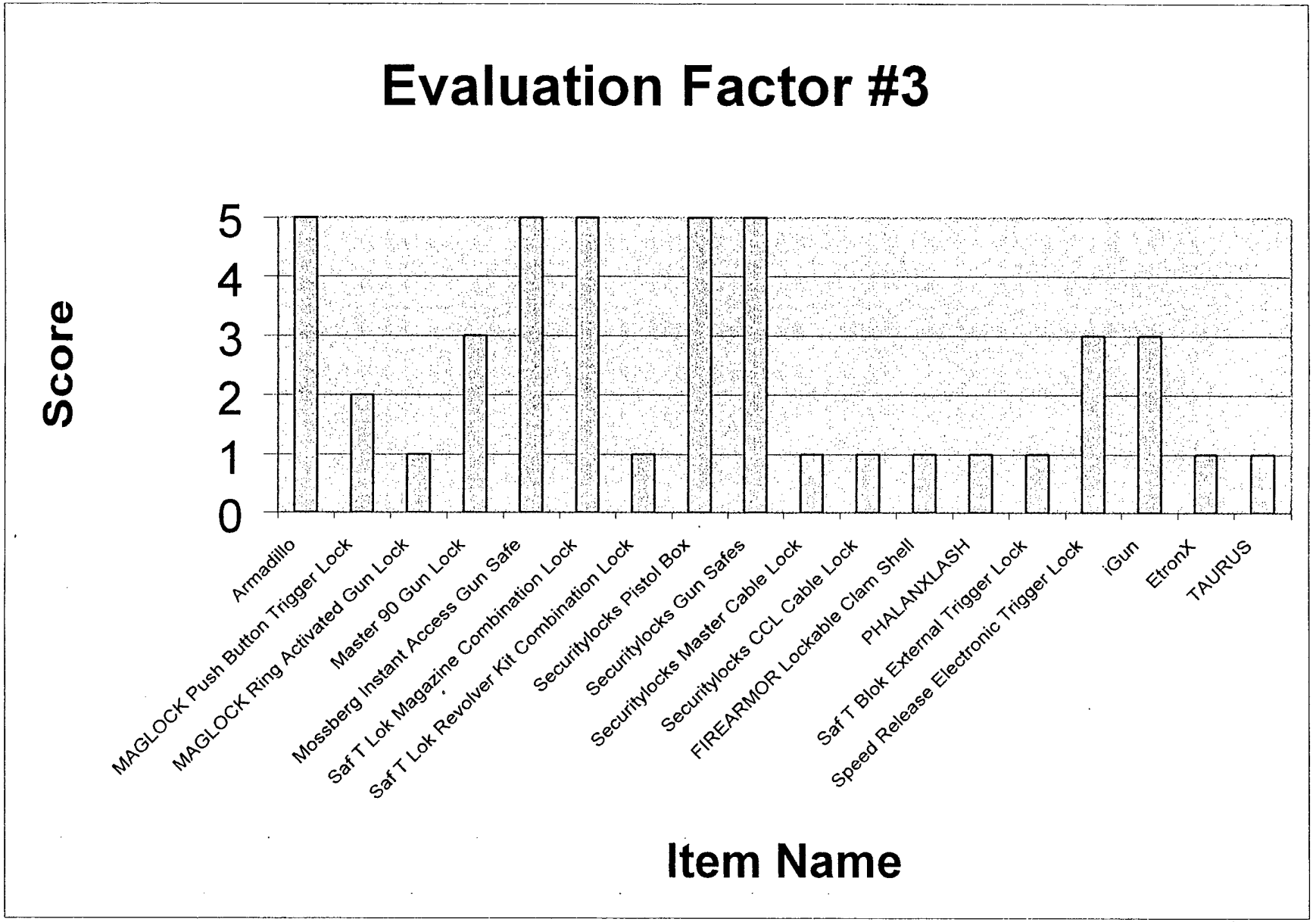
Personalized Weapons Technology Project

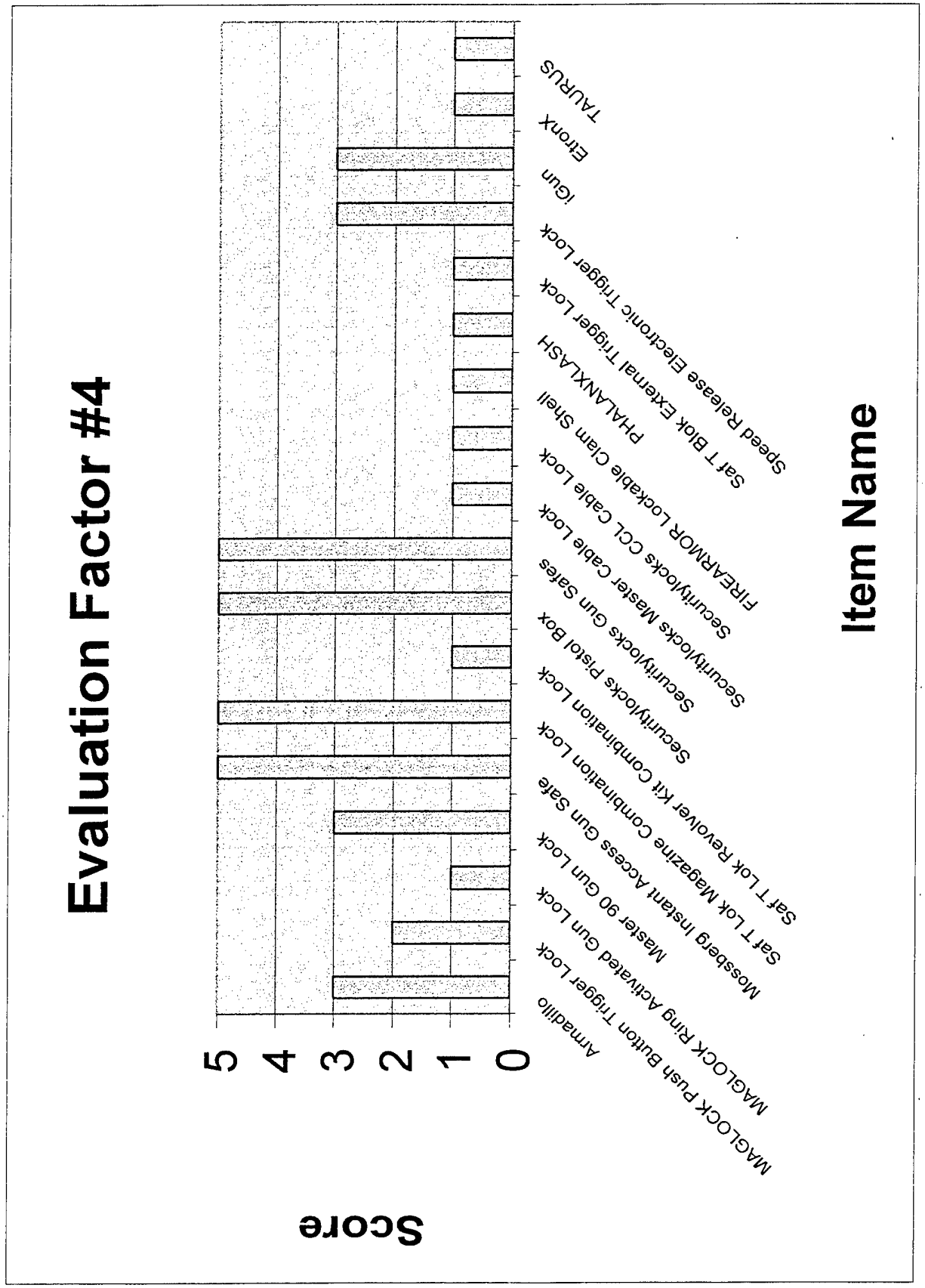
11/13/2000
a LMS Proc

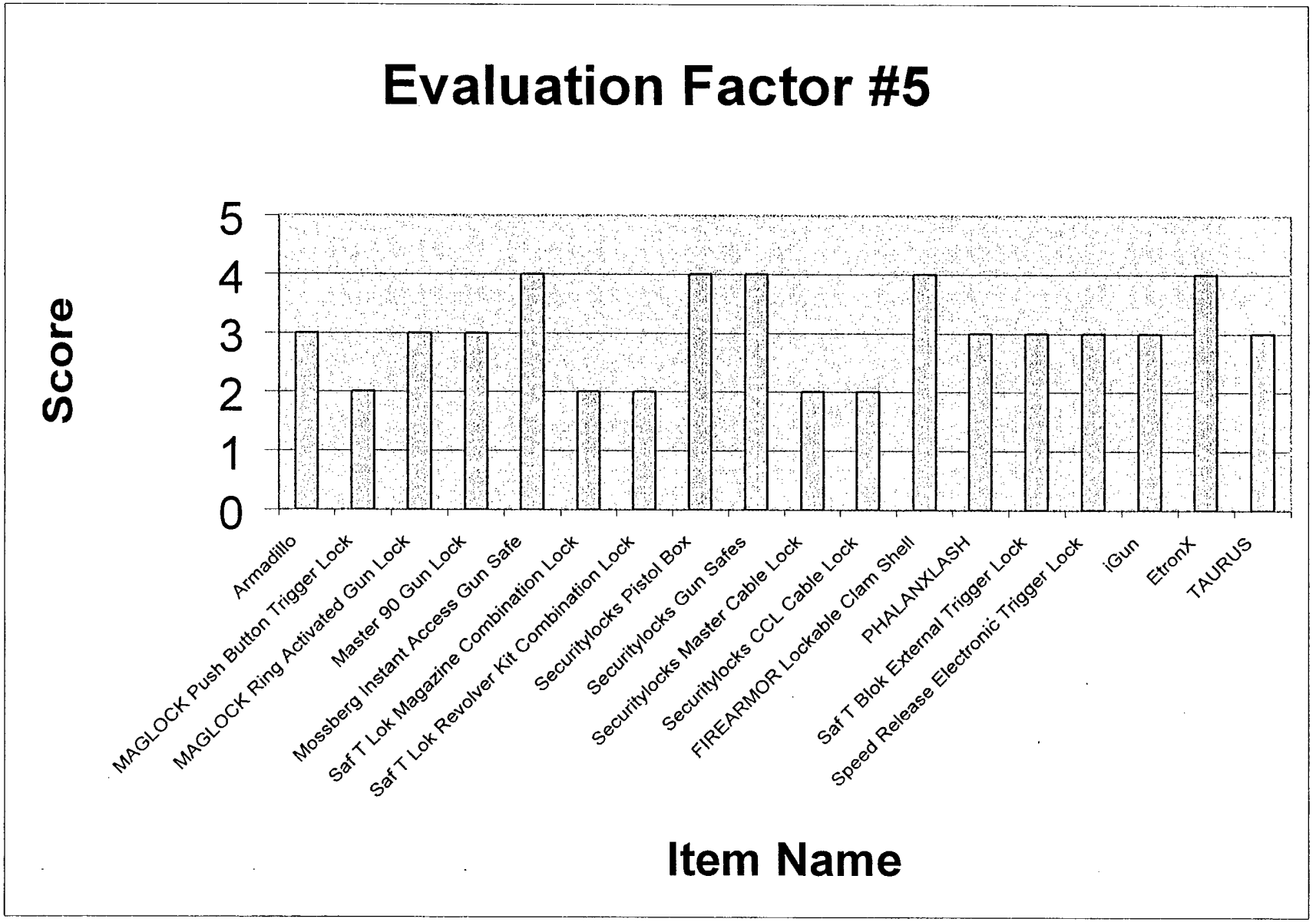
	Evaluation Factors															
Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**AVE**
Armadillo	5	2	5	3	3	4	4	0	5	1	5	1	1	9	0	3.2
MAGLOCK Push Button Trigger Lock	4	4	2	2	2	4	4	0	5	1	5	1	1	8	0	2.9
MAGLOCK Ring Activated Gun Lock	2	1	1	1	3	4	1	0	1	4	2	1	1	7	0	1.9
Master 90 Gun Lock	5	4	3	3	3	4	4	0	5	1	5	1	1	8	0	3.1
Mossberg Instant Access Gun Safe	5	4	5	5	4	5	3	4	5	3	5	1	1	9	1	4.0
Saf T Lok Magazine Combination Lock	2	2	5	5	2	3	3	0	5	3	3	1	1	7	0	2.8
Saf T Lok Revolver Kit Combination Lock	4	4	1	1	2	4	4	0	5	3	5	1	1	9	1	3.0
Securitylocks Pistol Box	4	4	5	5	4	4	4	0	5	3	5	1	1	9	0	3.6
Securitylocks Gun Safes	4	4	5	5	4	5	4	0	5	5	5	1	1	9	0	3.8
Securitylocks Master Cable Lock	5	4	1	1	2	5	4	0	5	1	4	1	1	9	0	2.9
Securitylocks CCL Cable Lock	5	4	1	1	2	5	4	0	5	1	5	1	1	9	0	2.9
FIREARMOR Lockable Clam Shell	4	4	1	1	4	4	3	0	5	3	5	1	1	9	1	3.1
PHALANXLASH	5	4	1	1	3	4	4	0	5	3	3	4	3	9	1	3.3
Saf T Blok External Trigger Lock	5	4	1	1	3	3	5	0	5	1	3	3	1	9	0	2.9
Speed Release Electronic Trigger Lock	4	4	3	3	3	4	3	4	5	2	2	1	1	9	0	3.2
iGun	5	4	3	3	3	3	1	3	5	4	3	1	1	6	1	3.1
EtronX	5	4	1	1	4	4	4	3	5	5	4	3	3	9	1	3.7
TAURUS	4	4	1	1	3	4	4	0	5	1	4	3	1	9	1	3.0
	4.3	3.6	2.5	2.4	3.0	4.1	3.5	0.8	4.8	2.5	4.1	1.5	1.2	8.5	0.4	

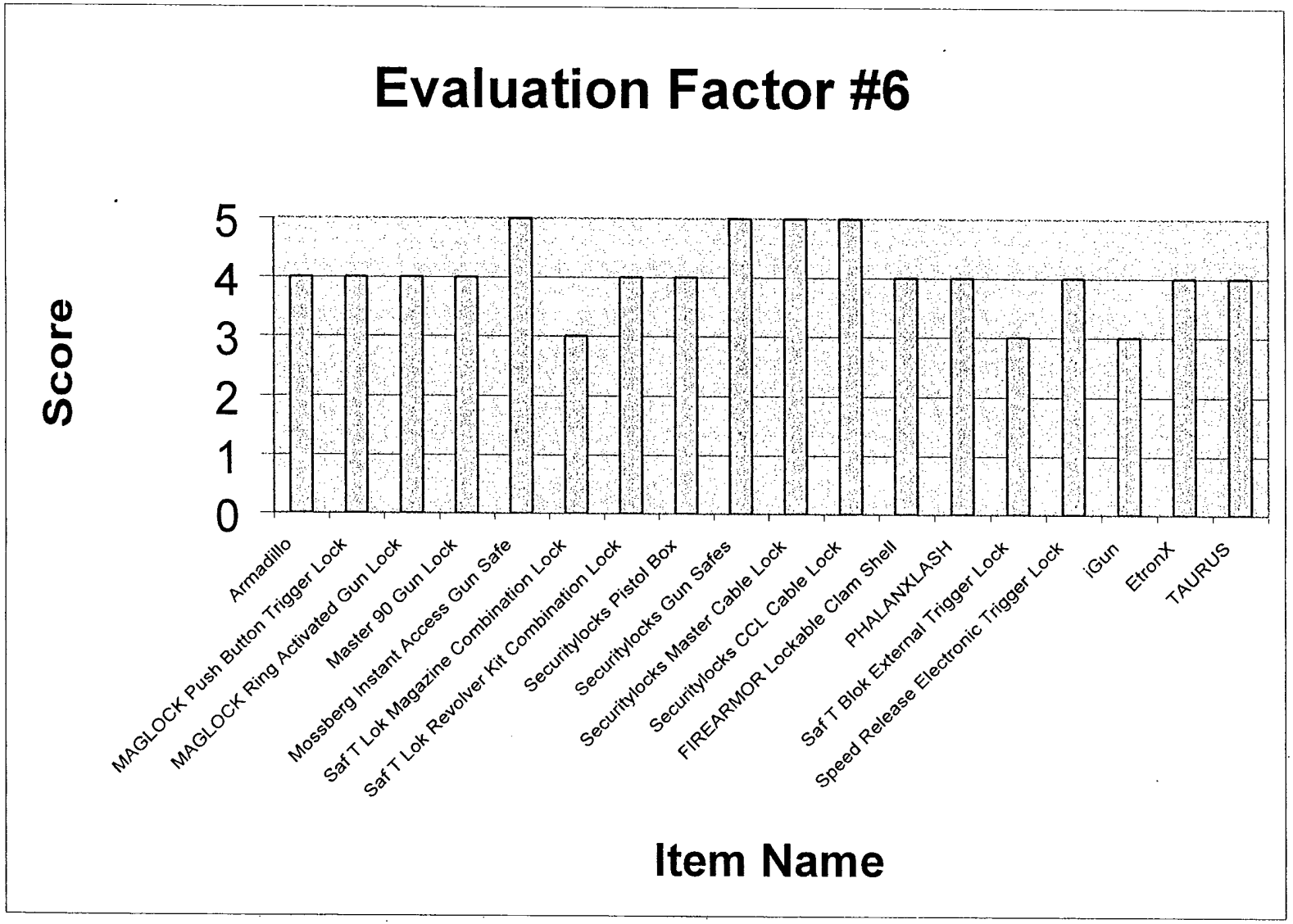

Evaluation Factor #1
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
TAURUS
Item Name

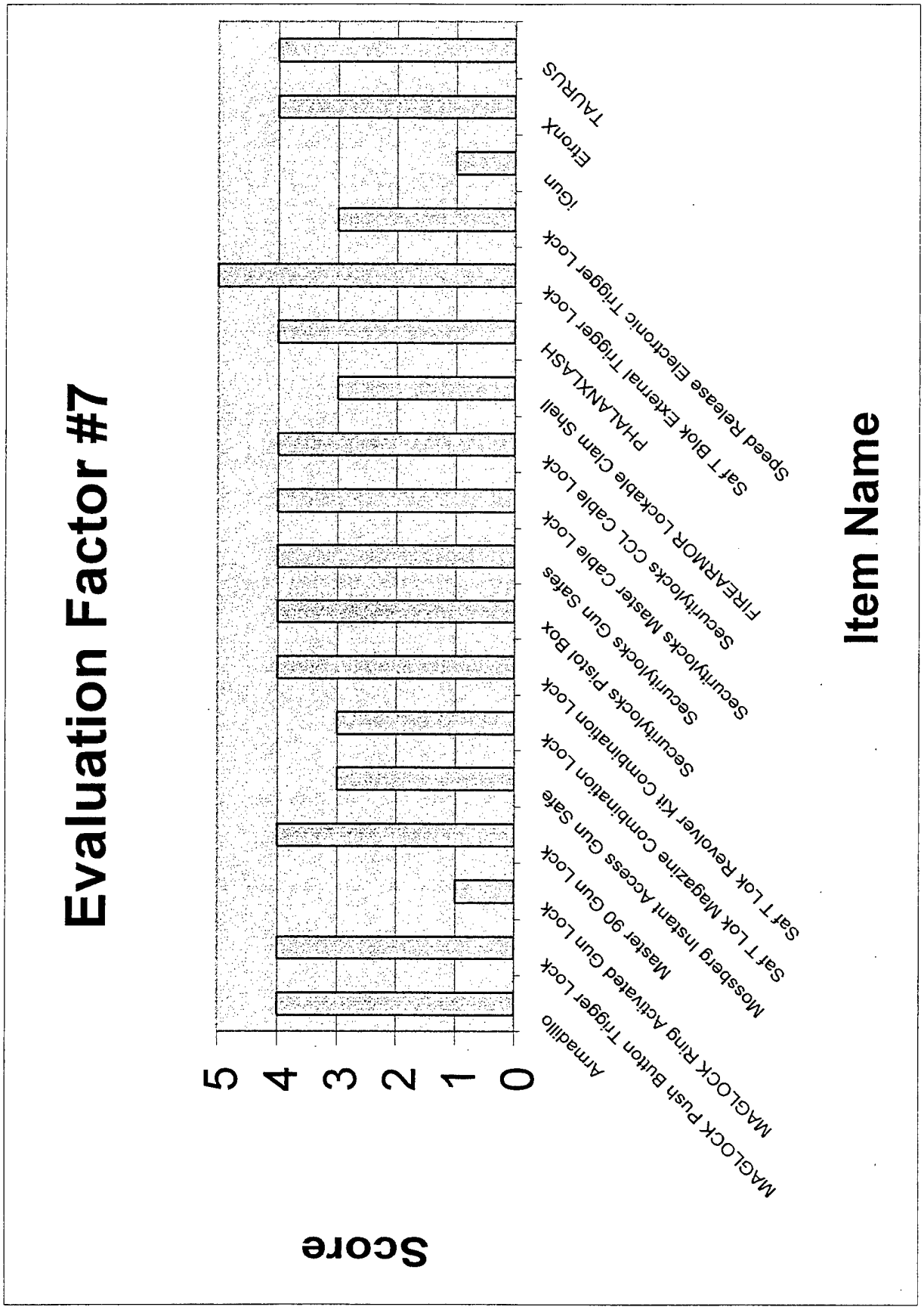

Evaluation Factor #2
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
TAURUS
Item Name

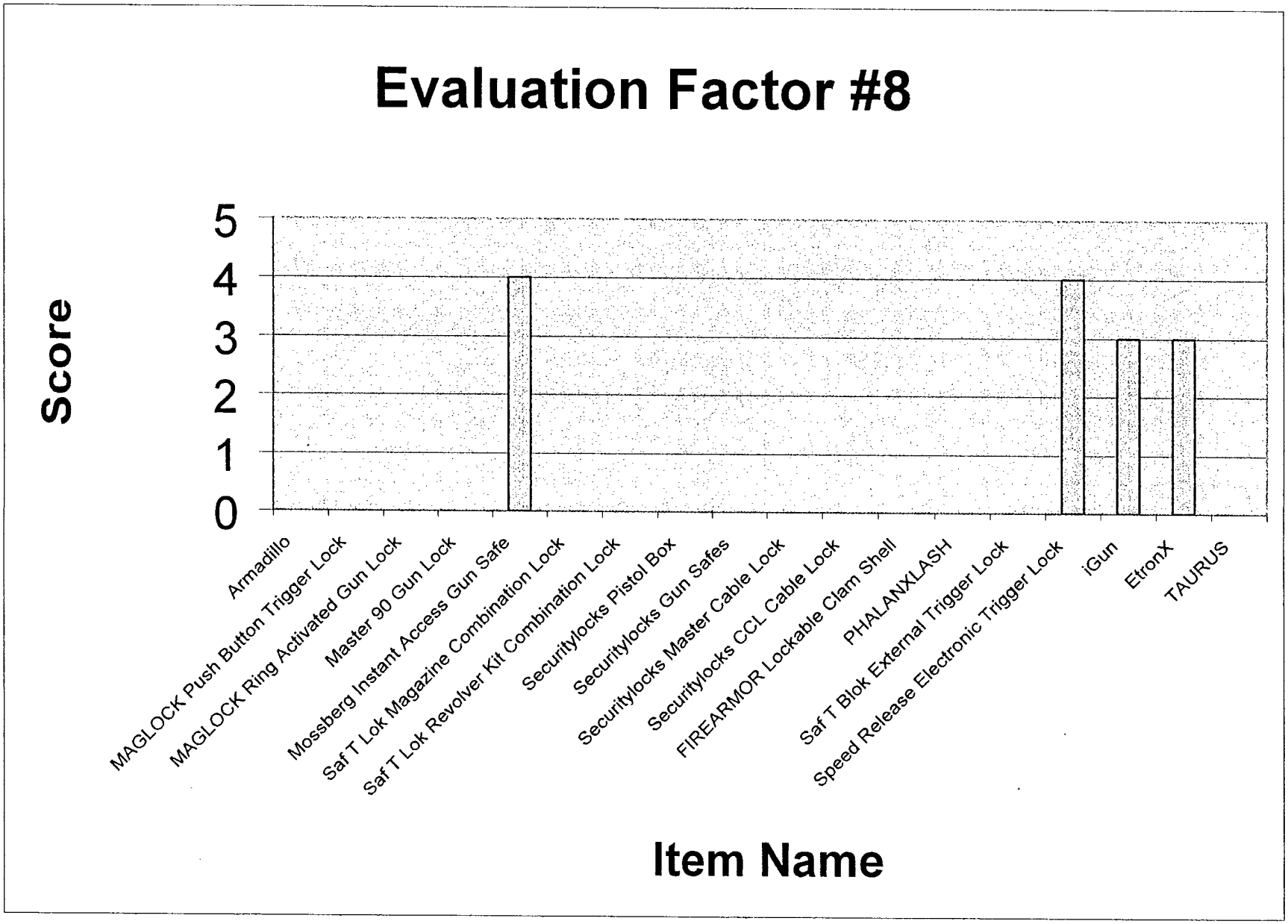

Evaluation Factor #3
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
TAURUS
Item Name

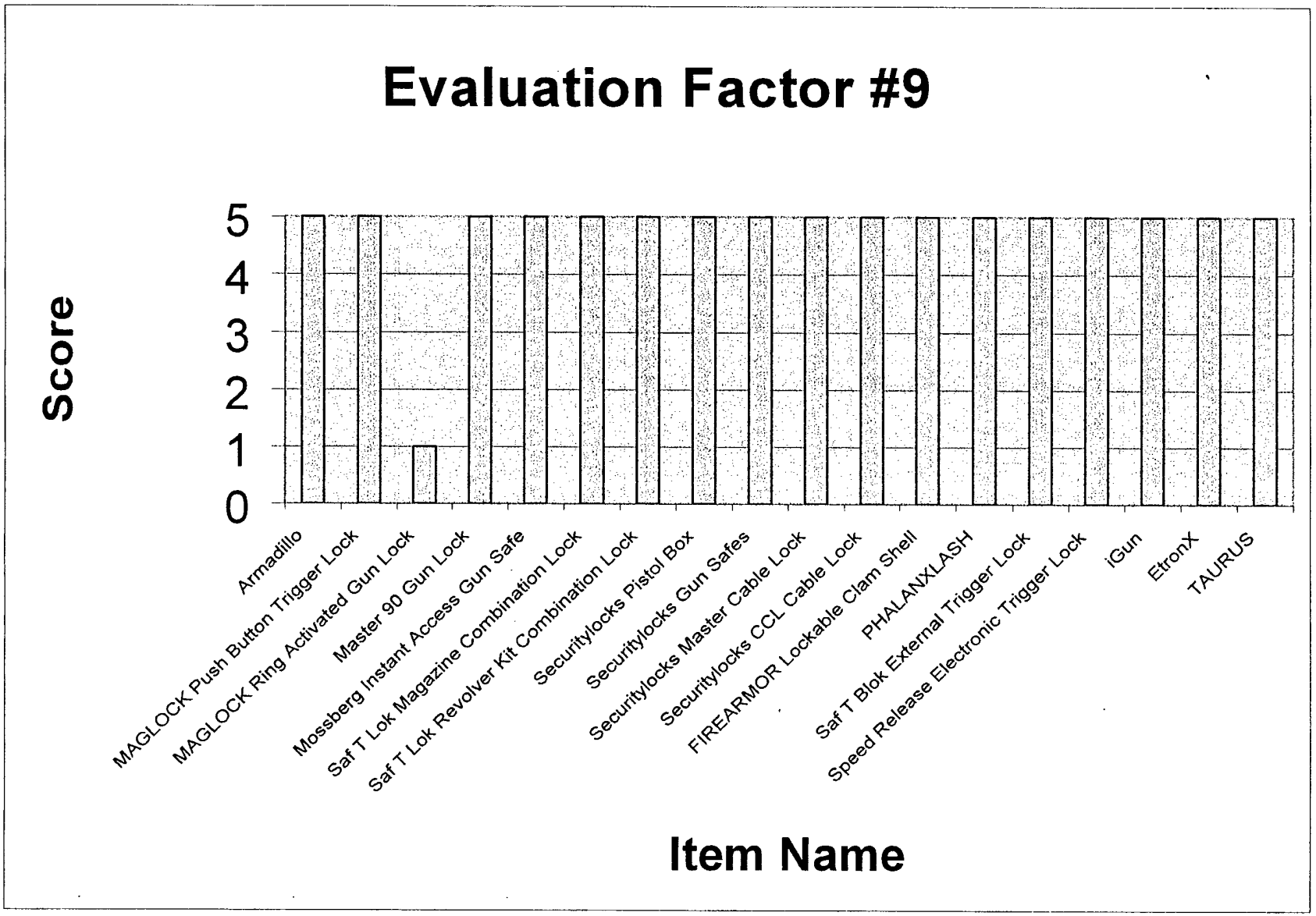

Evaluation Factor #4
Score
5
4
3
2
1
0
Item Name
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Mossberg Instant Access Gun Safe
Master 90 Gun Lock
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
SecurityIocks Pistol Box
SecurityIocks Gun Safes
SecurityIocks Master Cable Lock
SecurityIocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
Etronx
TAURUS

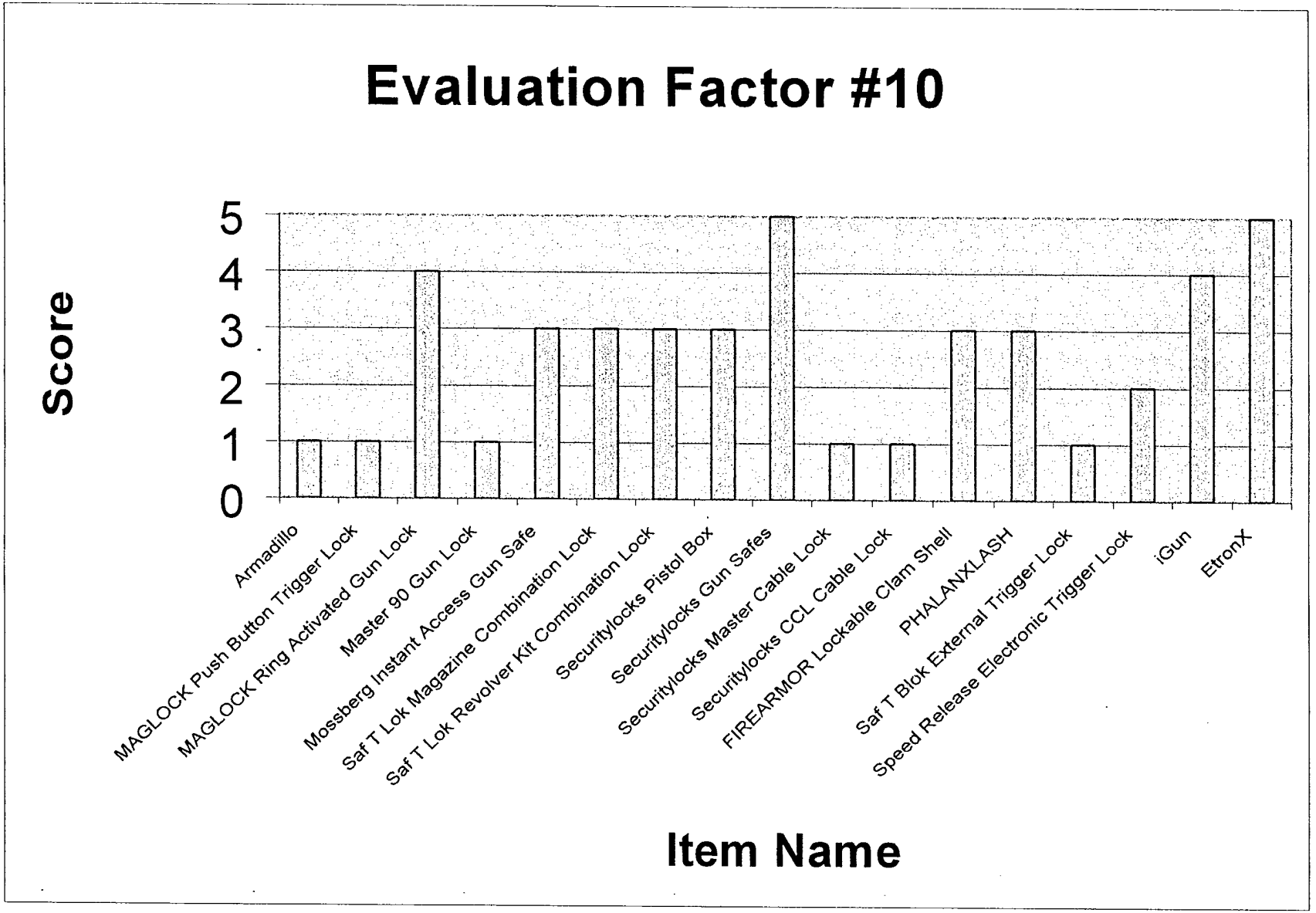

Evaluation Factor #5
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
TAURUS
Item Name

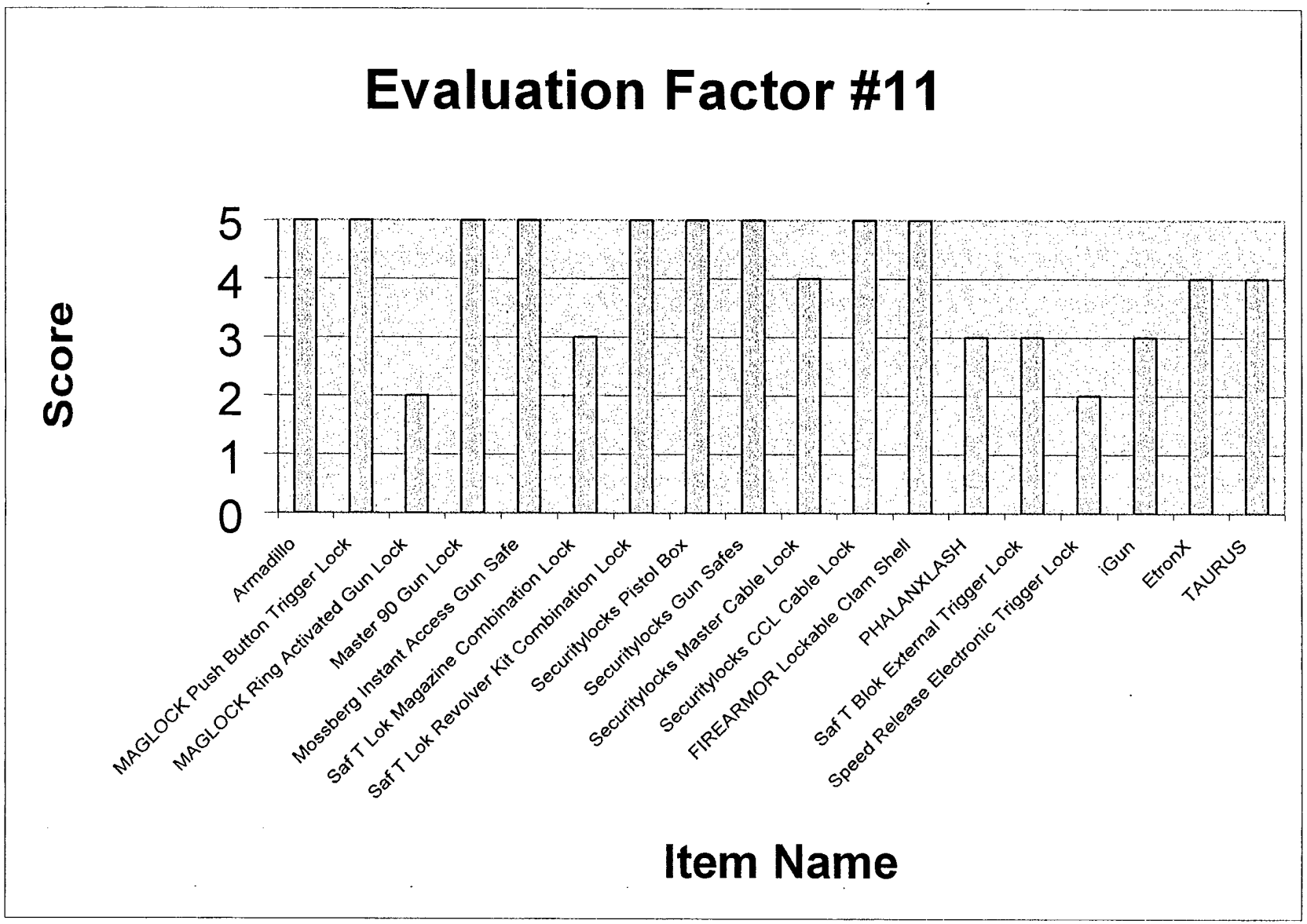

Evaluation Factor #6
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
TAURUS
Item Name

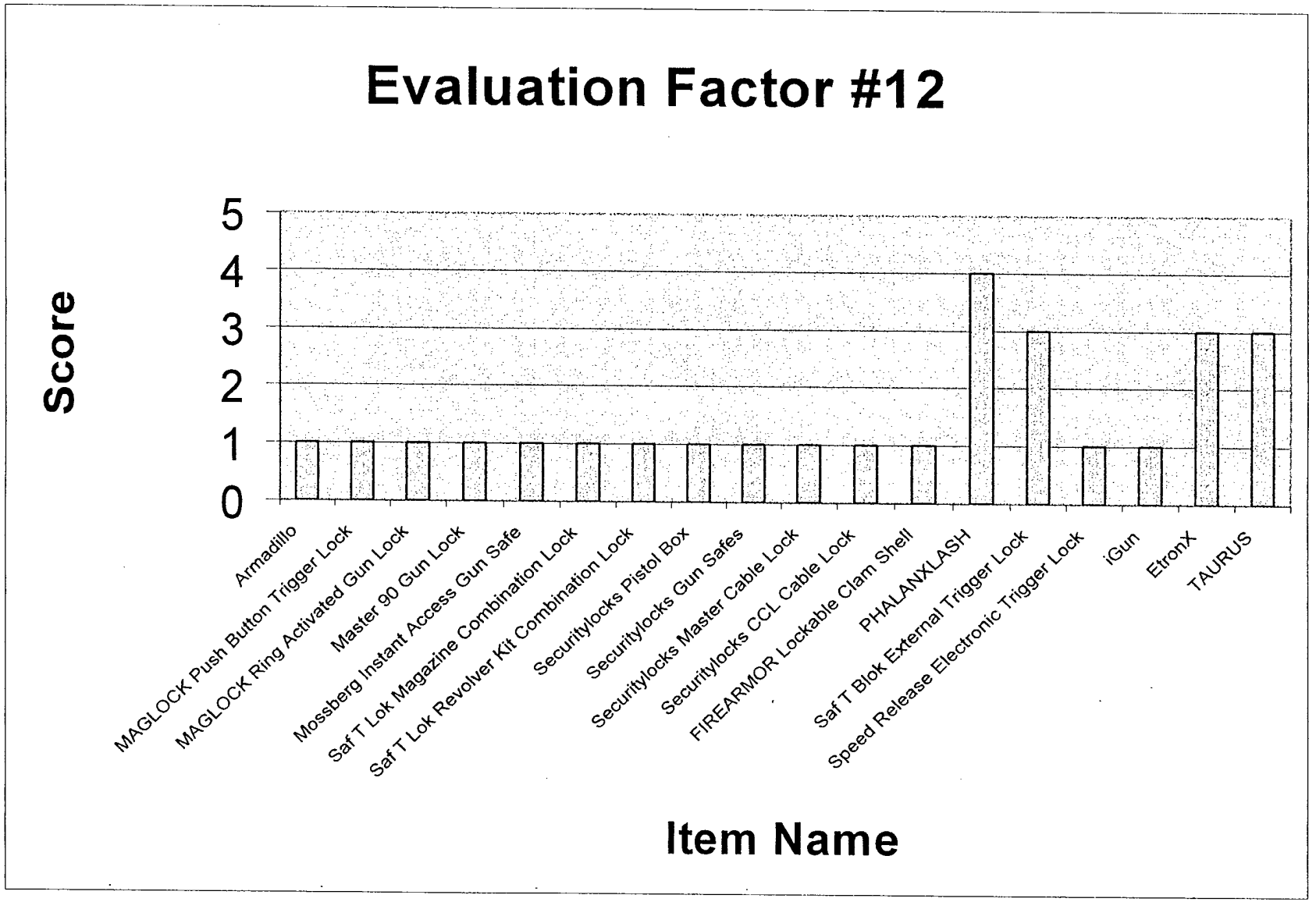

Evaluation Factor #7
Score
5
4
3
2
1
0
Item Name
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Mossberg Instant Access Gun Safe
Master 90 Gun Lock
SafT Lok Magazine Combination Lock
SafT Lok Revolver Kit Combination Lock
SecurityIocks Pistol Box
SecurityIocks Gun Safes
SecurityIocks Master Cable Lock
SecurityIocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
SafT Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
Eironx
TAURUS

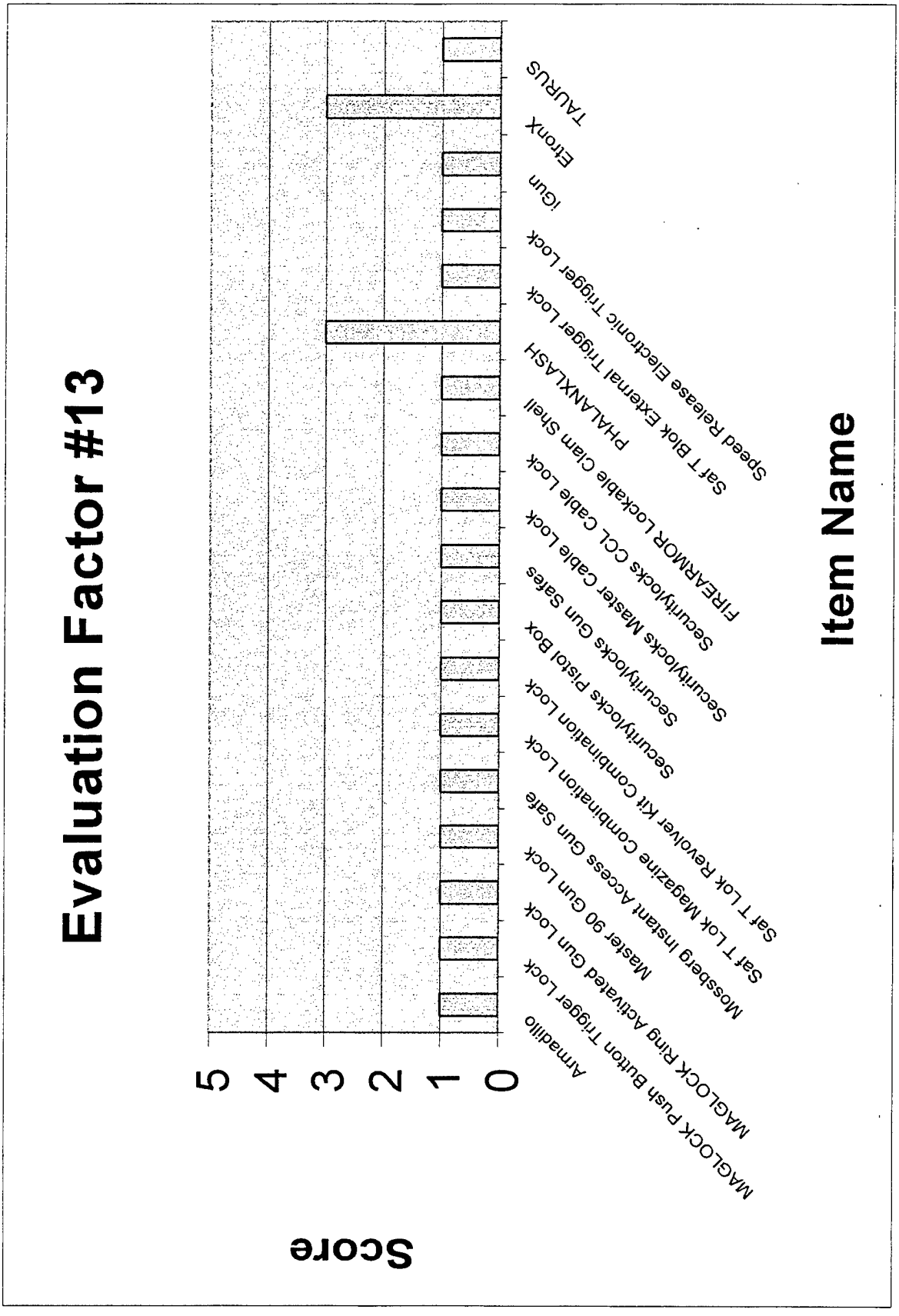

Evaluation Factor #8
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
TAURUS
Item Name

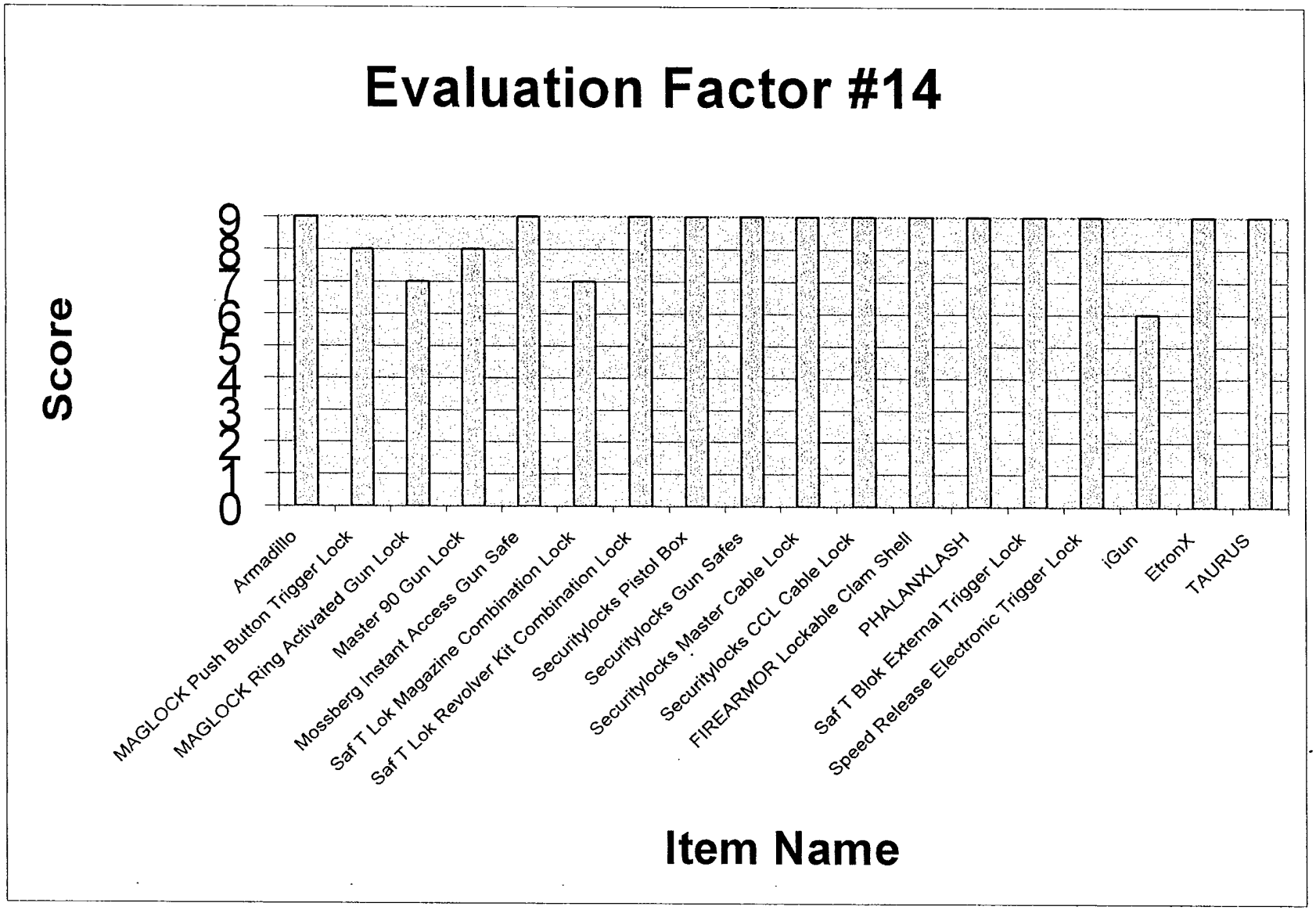

Evaluation Factor #9
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
TAURUS
Item Name

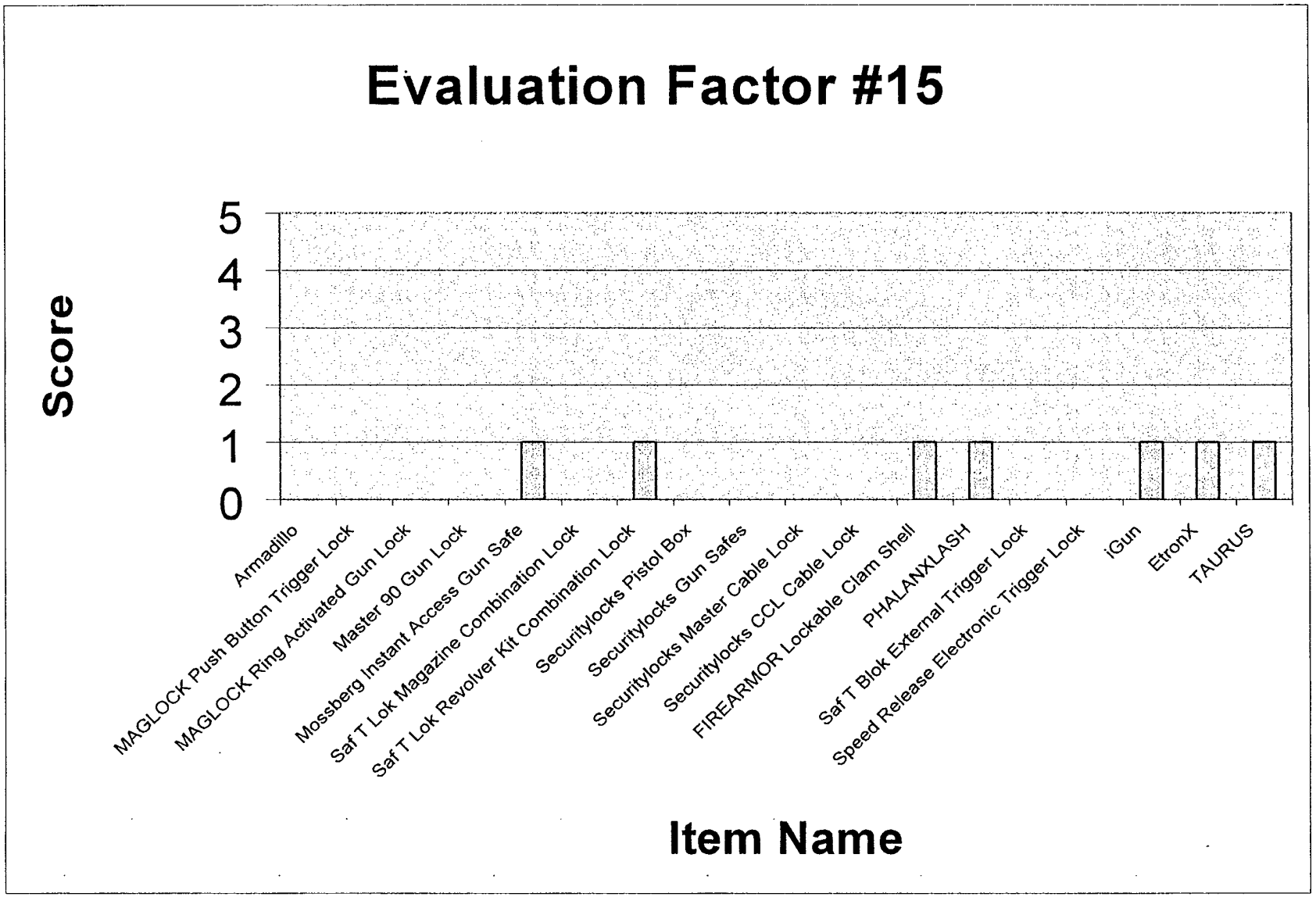

Evaluation Factor #10
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
Item Name


Evaluation Factor #11
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
TAURUS
Item Name


Evaluation Factor #12
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
TAURUS
Item Name


Evaluation Factor #13
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Mossberg Instant Access Gun Safe
Master 90 Gun Lock
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
SecurityJocks Pistol Box
SecurityJocks Gun Safes
SecurityJocks Master Cable Lock
SecurityJocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANX LASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
Eltronx
TAURUS
Item Name


Evaluation Factor #14
Score
0
1
2
3
4
5
6
7
8
9
10
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
TAURUS
Item Name


Evaluation Factor #15
Score
5
4
3
2
1
0
Armadillo
MAGLOCK Push Button Trigger Lock
MAGLOCK Ring Activated Gun Lock
Master 90 Gun Lock
Mossberg Instant Access Gun Safe
Saf T Lok Magazine Combination Lock
Saf T Lok Revolver Kit Combination Lock
Securitylocks Pistol Box
Securitylocks Gun Safes
Securitylocks Master Cable Lock
Securitylocks CCL Cable Lock
FIREARMOR Lockable Clam Shell
PHALANXLASH
Saf T Blok External Trigger Lock
Speed Release Electronic Trigger Lock
iGun
EtronX
TAURUS
Item Name

APPENDIX A
NJIT/ARDEC MOU

12 July 2000

MEMORANDUM OF UNDERSTANDING
BY AND BETWEEN
UNITED STATES ARMY
TANK-AUTOMOTIVE AND ARMAMENTS COMMAND
ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER,
PICATINNY ARSENAL, NJ
AND
NEW JERSEY INSTITUTE OF TECHNOLOGY (NJIT)

PURPOSE

This Memorandum of Understanding expresses the intent of the undersigned organizations to form a partnership to demonstrate approaches to smart gun technologies, and aid and assist in firearms related safety considerations within the private and public sectors. This new partnership will be considered an open relationship, one in which either party may select out of or expand upon as the relationship unfolds. This MOA represents an initial step in the development of more formal relationships that may involve:

- Collaboration in the research and development of smart gun technologies for military and civilian application
- Shared use of research and test facilities
- Joint pursuit of smart gun technology transfer between government, academic and private sector organizations

The initial effort will include as a minimum the following:

- Assist in the assessment of the current state of smart gun technologies and thereby help establish an accurate baseline
- Evaluate sources of newly emerging smart gun technologies
- Contribute expert opinion and thereby better inform efforts to develop an "authorized User-only small arms system".
- Jointly develop goals and strategies for future smart gun improvements

INTRODUCTION/BACKGROUND

The primary mission of the US Army Tank-automotive and Armaments Command, Armament Research, Development and Engineering Center (TACOM-ARDEC), located at Picatinny Arsenal, NJ is to conduct and/or manage research, development and life cycle engineering for assigned armament, munitions and fire control programs. The Arsenal is seeking to maximize its ability to transfer technology and intellectual property from military to commercial applications.

A key objective of NJIT is to provide University researchers with new knowledge with which to improve processes and products for industry. Through public and private partnerships and economic development efforts, the university helps to grow new business ventures that fuel the economy.

Based on the shared interest and mission of the above organizations, NJIT and TACOM-ARDEC have elected to collaborate to maximize smart gun efforts. It is anticipated that this agreement will be mutually beneficial for all parties involved as it allows the participants to explore innovative public/private partnership opportunities to leverage technology, equipment, facilities and other resources to achieve shared objectives and missions.

Project Goals

- To formalize a partnership between TACOM-ARDEC and the NJIT
- To integrate the mission objectives of TACOM-ARDEC and the smart gun technology objectives and strategic plan of the NJIT
- To provide access to the Advanced Technology Facility (ATF) for the demonstration of new technologies in support of smart gun development
- To collate information on enabling and innovative technologies
- To assist in the development of new mechanisms for the transfer of technology from military uses to commercial applications nationwide

Obligations of the Parties

This Memorandum of Understanding defines, in general terms, the basis on which the parties concerned will cooperate. This MOU does not constitute a financial or contractual obligation of any party. "Each party will assume the risks of its activities hereunder with neither party required to indemnify or hold the other harmless. Further, neither party warrants or guarantees its work, only that it will undertake its organization's "best efforts" to achieve the stated objectives of the project. It is also understood and agreed that if any inventions or original works of authorship arise from the collaboration, title to said inventions or works of authorship shall reside solely in the party who invented or created them (or held jointly if invented or created jointly). The parties will execute a separate Non-Disclosure Agreement, a copy of which is attached hereto and herby incorporated by reference, to govern the exchange of their respective Confidential & Proprietary Information." All parties reserve the right to terminate their participation in this project at any time; however, it is requested that any party contemplating terminating their participation in the project shall notify in writing all other team members within 60 days prior to the anticipated termination date.

Terms of Agreement

This agreement shall commence immediately upon execution by all parties hereto and remain in effect for two years. The terms of this agreement may be re-negotiated upon mutual consent of the undersigned parties. We, the undersigned, consent to the contents of this agreement.

Dr. Donald H. Sebastian Date
Vice President for Technology Development
New Jersey Institute of Technology,Newark, NJ

Mr. Michael Fisette Date
Technical Director
U.S. Army Tank-automotive and Armaments Command
Armament Research, Development & Engineering Center (ARDEC), Picatinny Arsenal, NJ

APPENDIX B

MINUTES OF THE PERSONALIZED WEAPONS TECHNOLOGY PROJECT MEETING

Minutes Of The Personalized Weapons Technology Project Meeting

BY

DR. JEFFERY WIDDER

On 26 Oct 2000 the Joint Service Small Arms Program (JSSAP) at the Picatinny Arsenal, NJ hosted a meeting between representatives from the New Jersey Institute of Technology (NJIT) and personnel from the Close Combat Armament Center (CCAC). The meeting was the first of a planned series following the July 2000 signing of a Memorandum of Agreement (MOA) between the Arsenal and the NJIT for support in the development and selection of technologies applicable for "Smart Gun" or "User Only" gun technologies. NJIT has been tasked by the State of New Jersey to research the state-of-the-art and near future technologies and systems with the goal of determining if they could reduce the number of accidental and purposeful shootings (to include suicide) by unapproved users of the weapon. The State of New Jersey has mandated that handguns be equipped with user identification or authorization technologies, when such technologies are available and developed to a suitable extent. These technologies also have potential application for use with future sophisticated small arms. Weapons such as the Objective Crew Served Weapon (OCSW) and Objective Individual Combat Weapon (OICW), if captured by enemy combatants could pose a significant threat to friendly forces. Technologies to disable the weapon and prevent unauthorized use are of interest to the US Army.

A list of attendees with contact information is given in appendix B.

In his welcome to the meeting attendees Mr. Kevin Fahey, ARDEC/CC, spoke to the significance of the meeting to minimize unnecessary/accidental firearms related deaths and to also potential usefulness of such technologies to the U.S. Army and the importance of the MOA. He noted that over 30 passwords are required for full up operation of a Bradley fighting vehicle and that advanced security systems are going to be needed on future advanced small arms.

Dr. Steve Small, JSSAP, gave an orientation briefing in which the four phases of the project were outlined and key questions for those phases were raised. The four phases are:

Phase 1: Literature search of the state-of-the-art
Phase 2: Technology selection and evaluation
Phase 3: Prototype modeling/fabrication
Phase 4: Prototype simulation/evaluation

The key questions raised are:

1: Are the technologies/concepts responsive to the NJIT metrics?
   a) Are only authorized users capable of using the weapon?
   b) Is the technology presently available?
   c) How can a firearm's mechanism be impaired to prevent the weapon from functioning?
2: What are the military off-ramps/on-ramps
   a) Identify Friend or Foe?
   b) Anti-theft/tracking capability?
   c) Others?

Dr. Don Sebastian, NJIT, gave a brief overview of the NJIT mission with regards to the smart gun technologies. He gave the NJIT definition of the function of smart gun technology as "To ensure a home owned guns is not abused by children or theft." This definition is based on a request made by the New Jersey legislature for assistance on safe gun development. He continued by discussing technologies in a very broad sense. Some technologies although they provide a high degree of security for the weapon require active input from a responsible owner. The State is interested in technologies that are "fool proof" and operate in the background, i.e. they do not require any active user input for correct and safe operation. NJIT and the State are interested only in systems that are applicable for "non-professional" weapons kept in private homes. Dr. Sebastian stated that advances in sensor technology and wireless combination should make it possible for NJIT to have a test platform for evaluation with a couple of years. The test platform is anticipated to use some kind of biometrics, i.e., voice, fingerprint, retinal scan, and/or grip recognition, to identify authorized users without a conscious input by the user. NJIT anticipates that multiple technologies will need to be incorporated into the weapon system to assure positive identification of the user and activation of the weapon. However if there is reasonable and reliable mechanical solution NJIT is interested in evaluating that as well as the more sophisticated electronic systems.

Lucian Sadowski, CCAC, ran the rest of the meeting, which consisted of reviewing and filling out an evaluation form on state-of-the-art technologies identified by the Phase I literature and Internet search. Lucian and NJIT were able to provide several handguns and a shotgun to aid the attendees in their evaluation of 7 locking devices (two were integral to the weapon) that had been purchased by or were on loan from the manufacturer to NJIT. An additional 11 products were also evaluated using information provided by the manufacturer or distributor. An interpretation of the answers provided by the attendees in the evaluation forms cannot be given, as the results are not yet available. Interpretations based on conversation during the evaluations and during the review stage are given below.

Three trigger locks were present for hands-on evaluation by the panel members—the trigger locks were manufactured by Armadillo, MAGLOC and Master Lock Company. There was a fourth trigger lock system manufactured by Speed Release that was evaluated based on literature obtained. The general consensus was that these locks were difficult to properly secure to the weapon to prevent a child or adolescent from twisting them loose and operating the trigger. This is because these locks are designed to fit as many weapons as possible. As a result it is difficult for the user to achieve the proper fit of the lock to the weapon trigger guard. For auto loading pistols and most long arms these types of locks do not prevent the weapon from being loaded. These types of locks most likely will prevent swing open revolvers from being loaded, however, they will not interfere with the loading of break open revolvers and single shot pistols. It was also noted by one of the CCAC engineers that these types of locks do not work on lever action rifles. These locks appear to be easily defeated by virtue of mechanical means due to the low mechanical strength of materials of manufacture. In fact one the locks broke prior to the meeting. Improvements to the these types of locks can be made by designing them to fit a smaller range of weapons or to have a self forming material that can be custom set the weapon being locked. Manufacturing these locks from steel instead of casting them from white metal would also improve their performance by making them significantly more difficult to defeat. The major draw back to this type of technology, even after improvement, is that it requires responsible and conscious use by the authorized user of the weapon and it does not allow for instantaneous use of the weapon.

The panel members also evaluated five gunlocks that were integral to the weapon. Two of the systems were available on loan by the manufacturers the other three systems were evaluated based on literature obtained. The first of the two hardware systems evaluated was the MAGLOC Ring Lock. This system consisted of a modified Model 1911 type pistol that required a specific magnetic ring be pressed against the grip of the pistol to unlock a block that prevented the weapon from firing. None of the attendees was able to make the weapon lock function as intended. To make the ring unlock the weapon required the use of two hands in a manner not conducive to proper or safe use of the weapon. Because this system only required what appeared to be a simple modification to the weapon it is most likely easy to defeat by removing the grip from the handle of the weapon. This system is designed to prevent immediate use by an unauthorized person who gains possession of the weapon. However, since it was very difficult for any of the attendees to make the weapon function with the authorization key, the weapon was essentially useless. A similar system manufactured by iGUN was evaluated based on literature obtained. This system had a more sophisticated ring that produced two recognizable signatures. The first was a magnetic field and the second was related to the metallurgy of the ring itself. A positive recognition by the weapon of both signatures is required for the weapon to function. Since there was no weapon/ring system to evaluate it was difficult for the attendees to determine if this system had any advantages over the MAGLOC system described above.

Saf T Lok manufactured the second integral gunlock that was available for hands-on evaluation. This system consisted of a combination mechanical lock that was secured to the right side of a Smith & Wesson J frame revolver. The lock appeared to block the function of the trigger, however it may have also blocked the operation of other internal parts of the weapon. To fire the weapon the user has to activate three spring-loaded pushbuttons a pre-selected number of times in a sequential order. The test model functioned as it was supposed and prevented operation of the firing mechanism of the revolver until the correct combination had been entered. It was not clear how easy it is to defeat the system without the use of mechanical advantage to break the components of the lock. Although easier to use correctly than the removable trigger locks previously evaluated, this locking system also prevents immediate use of the weapon by an authorized user. Also available for hands-on evaluation was second gun locking system also produced by Saf T Lok. The second system was a locking magazine that could be locked into the magazine well of a pistol to prevent the weapon from functioning and also block the advancement of ammunition into the chamber. The evaluation model provided to the attendees was a Beretta model 92. It was not clear to the attendees how this system prevented the weapon from functioning, and it appeared to be easily defeated. In fact prior to the meeting the device was damaged by manipulating the locked ammunition out of the magazine. This device does not allow immediate use of the weapon by an authorized user and it requires responsible and conscientious use by the authorized user.

The remaining two systems that incorporated integral locks in the weapon were reviewed based on literature obtained. The first of these two systems was the EtronX rifle produced by Remington Firearms. This system is designed for target and varmint hunting applications. The weapon uses electrically activated primers, which allows for a "match grade" trigger and a circuit interrupt to be used as a safety device. Remington has built the rifle such that a key is required to be in the weapon and rotated to the fire position for the weapon to function. This is a special purpose weapon system that requires the use of non-standard ammunition and may not be practical to legislate as mandatory for personal ownership of a weapon. However, since the system is controlled by an electrical circuit it may be better suited for application in a military environment where the weapon could be integrated into the digital battle field to achieve the various effects outlined in the questions raised during the orientation part of the meeting.

The second integral locking system reviewed using literature obtained was a series of integral locks that was installed by the weapon manufacturer Taurus. As an option for their line of auto-loading pistols and revolvers Taurus offers an integral key lock that is built into the weapon. They also offer a very inexpensive retrofit to any weapons of their own manufacture. Since very little information was available it was difficult to determine how robust and resistant to defeat the systems are. Because the system requires a key for operation it also does not permit instant use of the weapon by an authorized user.

There were five systems that could be classified as safes that were reviewed by the attendees. Four of these systems could be classified as portable safes, one of which was available for hands-on evaluation. These portable safes were suitable for only one or two handguns. Of the portable safes reviewed two completely encapsulated the weapon and the other two only partially enclosed the weapon. Mossberg manufactured the portable safe available for hands-on evaluation. This system had an electronic keypad combination and a backup battery and a very early warning of a low battery condition in the primary cell. The safe can be mounted to hard flat surface via a steel adapter plate, this allowed the safe to be fixed in place. A similar system called the Pistol Box was evaluated using literature obtained. The other two portable safes evaluated were the FIREARMOUR and the PHALANX LASH. The FIREARMOUR appeared to be of a clamshell design that clamped around the slide and trigger region of a pistol. The FIREARMOUR also comes with an aircraft cable and lock to allow the locked weapon to be locked to a rigid structure. The PHALANX LASH is actually a lockable pistol holster that has several functions and is designed to provide a higher level of security to a holstered pistol than a more conventional holster does. The system comes with a padlock that allows the pistol to be locked into the holster so that it cannot be made to function without breaking the lock and the holster. A line of fixed site safes was also reviewed based on literature obtained. These fixed site safes are designed to hold multiple long arms and handguns. The general opinion of the group seemed to be that these safes provided greater tamper resistance to the weapons than the trigger locks and cable locks reviewed. However the safes are only effective when the weapon is locked inside and they prevent immediate use of the weapon by an authorized user.

Literature on two cable lock systems was also reviewed. One of the systems used a key lock the other used a combination lock. These systems work by physically blocking either the bolt or cylinder of the weapon from closer and/or by also obstructing the barrel of the weapon. Although these systems do a reasonable job of preventing the weapon from functioning (while in place) and can be used on a wide variety of weapons, wire, cable, or bolt cutters easily defeat them, and they prevent immediate use by authorized users. These systems like the safes and trigger locks also require responsible and conscientious use by the authorized user to be effective.

The only remaining system that was evaluated was the Saf T Blok. The Saf T Block was evaluated based on literature obtained. This devise is specific for Glock pistols and physically blocks the rearward motion of the trigger when it is in placed. The device is designed to be dislodged from the pistol onto of the shooter's fingers or thumbs. Its primary purpose is to prevent accidental discharge during drawing of the weapon and to temporarily disable the weapon should the weapon be obtained by an adversary. This system did however come with a small padlock that allows the Saf T Block to be locked in place on the pistol. The size of the padlock though suggests that it can be easily defeated. The system also does not prevent the weapon from being loaded.

After reviewing the 18 items Larry Ostuni spoke about a methodology that could be used to review the present technologies and move them towards the desired goals. For each of the

technologies reviewed had positive and negative aspects. The question arises how can these technologies be improved to move them towards the desired goal. There are two types of improvements that can be done those that use existing technology and can be implemented immediately and those that rely on future technologies that are not immediately available. Larry than took the 18 technologies and broke them down into four categories:

1) Habitual: trigger locks and safes
2) Some Innovation: magnetic ring activated locks
3) New and Novel: EtronX rifle
4) Far Out: biometrics to identify authorized users, finger print, retinal scan, grip pattern recognition. None of the 18 evaluated technologies fell into this category.

Categories 1 to 3 are the "box" or existing technologies. None of these technologies though fulfills the NJIT requirements for a suitable smart gun. It is not likely that we can substitute, combine, or adapt any of the reviewed technologies to the reach the end goal. Larry than asked what can be done to break out of the box? Are there far out concepts that can be realized with future technologies, and are there existing technologies used in unrelated fields that can be identified and adapted to produce the desired smart gun technologies?

As an example of his methodology Larry walked the group through an analysis of trigger lock technologies. Based on the group's examination and evaluation of the trigger locks made available lists of the weaknesses, possible solution, and desirable characteristics were made.

Trigger Lock Weaknesses:

1) One size fits all, resulting in poor fit to most weapons, difficult to install.
2) Easily defeated if not installed properly installed.
3) Materials of construction are not robust, resulting in easy defeat by mechanical means.
4) Active system, it requires attentive user input for optimal performance.

Solutions for Trigger Lock Weaknesses:

1) Construct from stronger materials.
2) Adjustable or moldable form to custom fit the weapon for secure fit.
3) Change gun design to be better suited for use with a trigger lock.
4) Install electronic transplant in the brain of the user to force use of trigger lock on weapon. ("Out of the Box thinking" received emphasis by Larry during this phase of the discussion)

Present Characteristics of Trigger Lock Technologies Contrasted to the Desirable Smart Gun Characteristic:

1) Presently the lock needs to be present to PREVENT the weapon from functioning vs. it is desirable that the "default" weapon state be one of non-function and that some kind of device be present for the weapon to function. The device could be a magnetic key, a bar code or biometrics of the authorized users.

2) Present trigger locks are difficult to properly fit/install on weapon vs. a form fitted trigger lock or block. Possible solutions suggested included a reversible phase change material that could prevent any motion of the trigger.

Larry then led the group in a second exercise in which a plastic soda bottle was analyzed and its characteristics related to desirable smart gun characteristics.

Soda Bottle Characteristics

1) Instantly identify by sight if the bottle is empty or full.
    a) Is the weapon loaded or unloaded.
2) What is the effect of the bottle/smart gun shape?
    a) Fit one person's hand or every hand?
    b) Is it user friendly?
    c) Does it allow rapid access?
3) The label says the contents are nourishing
    a) Can the smart gun technology be nourishing for the weapon, i.e. the locking system provides the user with peace of mind, the locking system could also provides corrosion inhibition, informs the user of the weapon status etc...
4) Additional comments/questions resulting from the bottle discussion.
    a) Can the safety device include a tracking device for location of a lost or stolen weapon?
    b) Can the safety device incorporate an active defense to prevent unauthorized use?
    c) Can the safety device incorporate a tamper indicator to show unauthorized handling of the weapon? i.e. the lock changes color.

Larry initiated a third discussion about the portable Mossberg safe that was reviewed by the attendees. Again the weaknesses of the technology with regards to the requirements of NJIT were identified and possible solutions were suggested.

Weakness of Portable Safe:

1) Too small for larger than conventional pistols and revolvers.
2) Only holds one or two handguns.
3) Only effective when the weapon is locked in the safe.
4) Too heavy.

Possible Solutions and Additional Insights:

1) Safe/weapon provides some kind of tamper indication.
    a) Dispenses a dye marker.
    b) Phones an authority.
    c) Interfaces to personal computer for logging of all actions.
    d) Captures fingerprint of unauthorized user.
    e) If stolen changes the color of weapons for tracking.
    f) If stolen the gun gives off an audible alarm.
    g) If stolen the gun dispenses a foul odor.
    h) If stolen the weapon renders itself inoperable.
2) Safe expands to fit multiple or larger weapons.
3) Safe material is expandable and flexible, but hardens upon tampering.

Larry than ended the secession by commenting that he liked the idea of an expandable safe and posed the question to the audience: "Were do we go from here?" and then left the floor open for discussion. For the NJIT smart gun the lock has to be integral to the weapon and the key has to be unique to the authorized user. Frank Dindl raised the idea that a smart gun could try and disable an

unauthorized user via an electrical shock, numbing of the hand, or induce muscle spasms in the hand. Clark Fishman asked the group to consider if there were ways that the ammunition could be made smart as well so that the ammunition could be used to disable the weapon. Another person raised the possibility that future smart materials could be incorporated into the smart gun technology to achieve these affects.

For the NJIT smart gun positive differentiation of authorized and unauthorized users is paramount. The state-of-the-art technologies reviewed in Phase I by the meeting attendees all fail to do this. To positively differentiate between an authorized and unauthorized user the mechanism (i.e. the key) to make the weapon operational has to be unique to the authorized user. All of the present systems relied upon combinations, metal or magnetic keys to make the weapon operational. These systems are not unique to the operator and can be easily defeated. Findings indicate that mechanisms by which positive identification of authorized verses unauthorized users can be made. Biometrics is the most likely type of technology that can provide this type of accurate identification. New technologies developed for electronic commerce such as fingerprint identification, retinal scan identification, hand-grip identification are all likely candidates for the future smart gun systems. The most reliable smart guns will most likely utilize multiple biometrics to ensure reliable and accurate identification of authorized users. Phases II to IV of this program will have to identify and then utilize appropriate biometrics based technologies in the development of the final demonstrable prototype.

APPENDIX C
LIST OF ATTENDEES

List of Attendees

Name	Organization	e-mail	Autovon	Commercial
Steve Small	JSSAP	ssmall@pica.army.mil	880-7043	973-724-7043
Jeff Widder	Battelle	widderj@battelle.org		410-569-0200
Frank Dindl	CCAC	fdindl@pica.army.mil	880-6761	973-724-6761
Lucian Sadowski	CCAC	sadowski@pica.army.mil	880-2555	973-724-2555
Walter Gill	NJIT	wgill@pica.army.mil	880-3536	973-724-3536
John Lacontory	NJIT	lockjm@prodigy.net		609-476-3408
Mike Liska	NJIT	liska@adm.njit.edu		973-596-3430
Don Sebastian	NJIT	sebastian@njit.edu		973-596-3615
Bill Marshall	NJIT	marshall@adm.njit.edu		873-596-3430
Phil Baker	CCAC	pbaker@pica.army.mil	880-3943	973-724-3943
Piots Frey	CCAC	pfrey@pica.army.mil	880-6085	973-724-6085
David Skeldon	CCAC	dskeldon@pica.army.mill	880-3949	973-724-3949
Sergio J. Aponte	CCAC	saponte@pica.army.mil	880-6762	973-724-6762
Joe Giamiapa	NJIT	giampapa@njit.edu		973-596-5825
Clark Fishman	FSAC	cfishman@pica.army.mil	880-6940	973-724-6940
Larry Ostuni	Consultant	lostuni@tellurain.net		973-383-8384
Bud Romaine	CCAC	bromaine@pica.army.mil	880-2549	973-724-2549

APPENDIX D
ORIENTATION BRIEFING

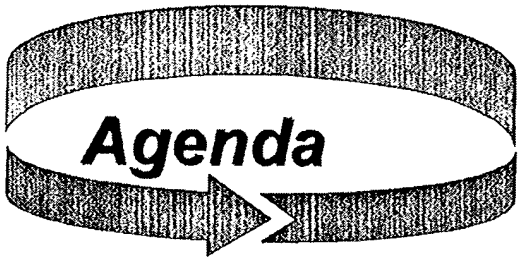
The Joint Service Small Arms Program (JSSAP)

Personalized Weapons Technology Project

NJIT

NJIT is a Public Research University

Stephen C. Small, Ph. D.



Personalized Weapons Technology Project

NJIT

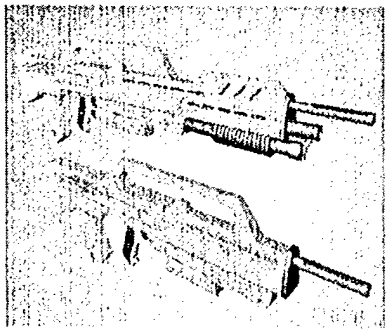
NJIT is a Public Research University

J·S·S·A·P JOINT SERVICE SMALL ARMS PROGRAM

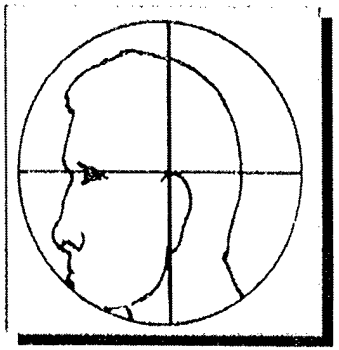
0900 Welcoming	Kevin Fahey
0915 Orientation	Steve Small
	William Marshall
0930 Tech Overview	Lucian Sadowski
1130 Lunch	
1230 Brainstorming	Larry Ostuni
1500 Complete written Summaries	All
1600 Plans & Conclude	Steve Small

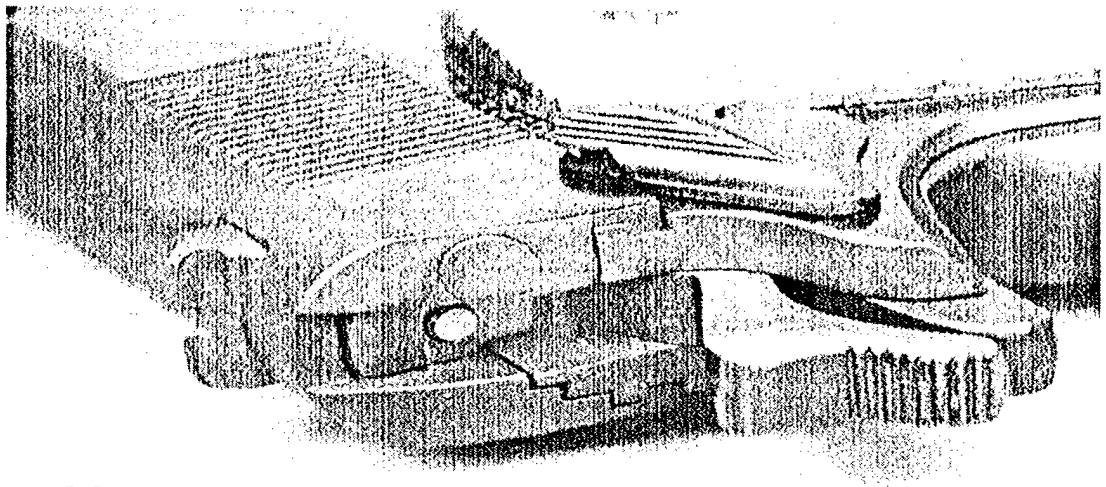
The Questions

- Are the technologies/concepts responsive to the NJIT metrics?
  - Is it authorized user(s)-only operational?
  - Is it "here & now" regards its maturity?
  - How might firearm architecture be best impaired?
- What (if any) are the military off-ramps/on-ramps?
  - IFF?
  - Anti-Theft/Tracing?
  - Other?



What is a Safe Gun?



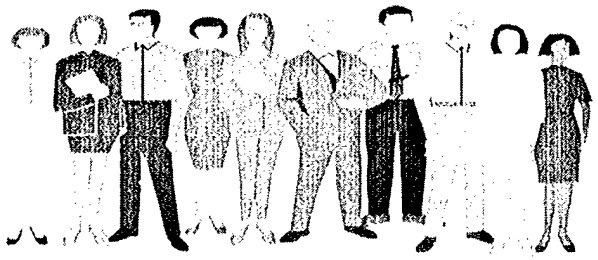


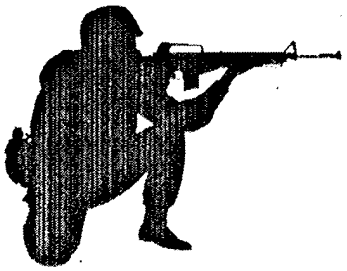
HUMAN BEINGS UNDERSTAND
REASON, COMPASSION, DIGNITY

PREDATORS UNDERSTAND STRENGTH

Safe Gun Players

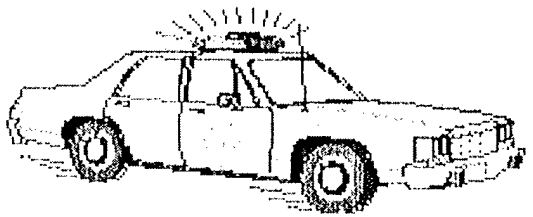
- July 2000 – ARDEC Technical Director Signs Memorandum Of Agreement With The New Jersey Institute Of Technology (NJIT)
- Stakeholders
  - Law Enforcement
  - Civil Community
  - Military?





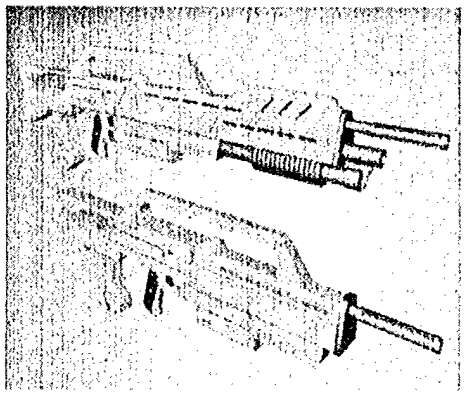
NJIT Project Mission

- Project Mission
  - Survey and Assessment
  - Reliability
  - Implementation Time Frame
  - Stakeholder Contribution



NJIT Project Mission

- Project Plan
  - Phase 1 - Literature Search
  - Phase 2 - Tech Selection and Evaluation
  - Phase 3 - Prototype Modeling/Fabrication
  - Phase 4 - Prototype Simulation/Evaluation

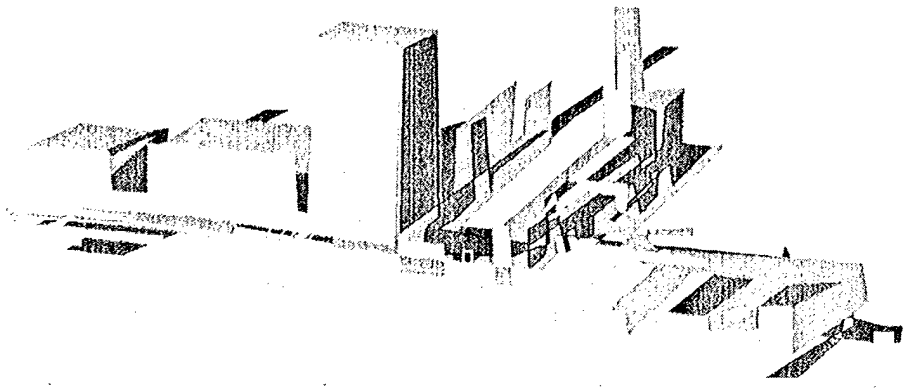


NJIT Project Mission

- Initial Technologies To Be Reviewed
  - Radio Frequency Tags
  - Remote Control
  - Touch Memory
  - Lock Systems
  - Biometrics I.D./Recognition

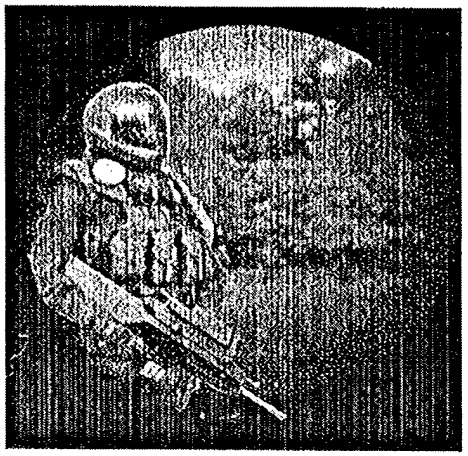
NJIT Project Mission

- Initial Technologies To Be Reviewed (continued)
  - Voice
  - Fingerprint
  - Grip Pattern



Plans

- Worksheets And Executive Summary
- NJIT/JSSAP Smart Gun Conference
  - Feb./March '01 Timeframe
  - A Day and ½ in duration
  - Government, Academe and Industry Involvement
  - Law Enforcement/Civil Focus
  - Possible Military Off-ramps



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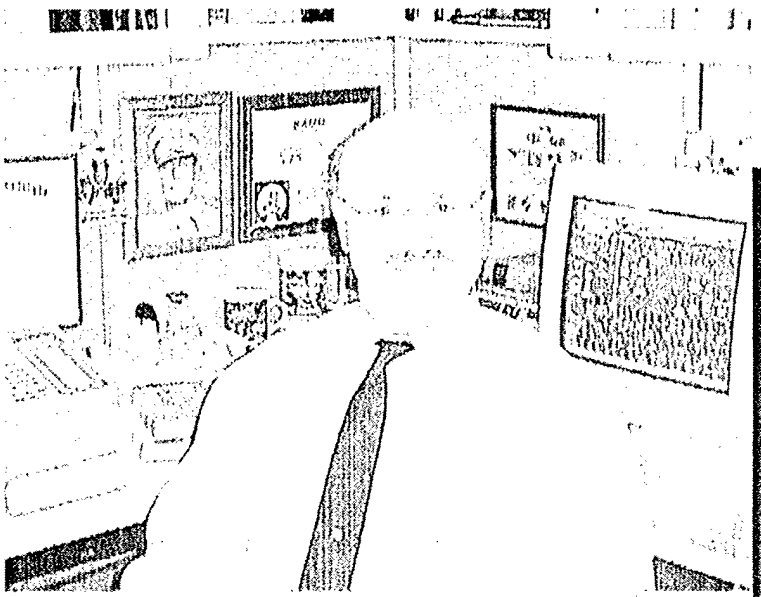

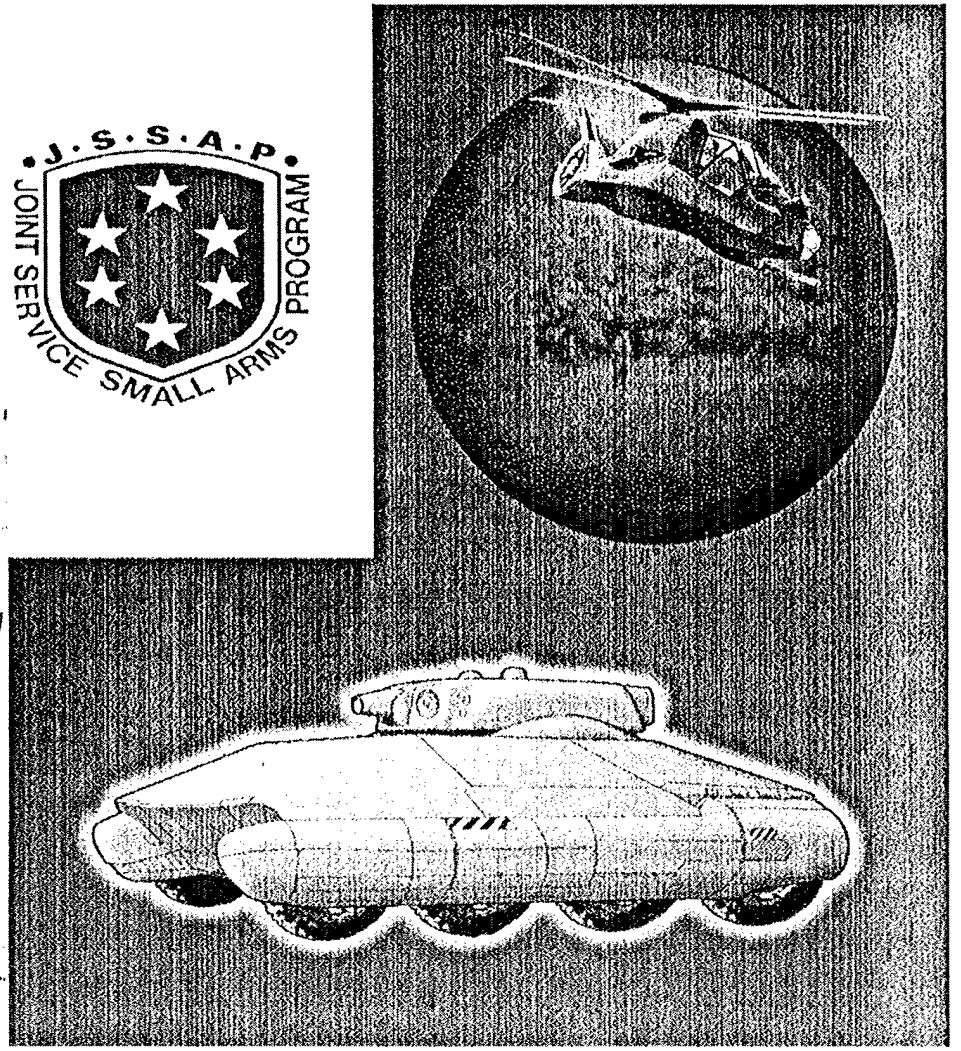

APPENDIX E
TECHNOLOGY EVALUATION WORKSHEET AND READINESS

Evaluation Sheet

Personalized Weapons Technology Evaluation

Item Name: _____

Manufacturer: _____

Evaluator's Name: _____ Date: _____

Circle only one number for each evaluation factor.

1. Ease of Use (5 = Easy, 1= Impossible)	5	4	3	2	1
2. Quickness of Safe to Arm (5 = Instantaneous, 1= Minutes)	5	4	3	2	1
3. Interference with operation of the weapon (5 = No interference, 1= Weapon will not operate)	5	4	3	2	1
4. Interference with functioning of the weapon (5 = No interference, 1= Weapon will not function)	5	4	3	2	1
5. Time to Defeat Mechanism (5 = Never, 4 = Hours, 3 = Minutes, 2 = Seconds, 1 = Instantaneous)	5	4	3	2	1
6. Lifetime of the Device (5 = infinite, 1= one round)	5	4	3	2	1
7. All Weather Capability (5 = Excellent, 1 = Poor)	5	4	3	2	1
8. If Battery is required for operation (5 = Strongly Approve, 1 = Strongly Dislike)	5	4	3	2	1
9. Multiple Users (5 = Numerous, 1 = Only one)	5	4	3	2	1
10. Cost (5 = Too Expensive, 1= Affordable)	5	4	3	2	1

Evaluation Sheet

Circle only one number for each evaluation factor.

11. Applicable for Home Use (5 = Very, 1 = Not Applicable)	5	4	3	2	1
12. Applicable to Law Enforcement (5 = Very, 1 = Not Applicable)	5	4	3	2	1
13. Applicable to Military Use (5 = Very, 1 = Not Applicable)	5	4	3	2	1

Describe the Positive Attributes:

Describe the Negative Attributes:

14. Technology Readiness Level - TRL (Choose a number from 1 to 9) _____

15. Based on your comments above, do you recommend this device for further investigation ? (Circle one) YES NO

Evaluation Sheet

TECHNOLOGY READINESS LEVELS (TRL)

Level Description

1. Basic principles observed and reported
2. Technology concept and/or application formulated
3. Analytical and experimental critical function and/or characteristic proof of principle
4. Component and/or breadboard validation in laboratory environment
5. Component and/or breadboard validation in relevant environment
6. System/subsystem model or prototype demonstration in a relevant environment
7. System prototype demonstration in an operational environment
8. Actual system completed and "flight qualified" through test and demonstration
9. Actual system "flight proven" through successful mission operations

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